Monitoring the Weather and Climate of Colorado

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Atmospheric Science Department

Presented to Gamma Sigma Delta Seminar Series, September 28, 2005, Colorado State University, Fort Collins, CO

Prepared by Odie Bliss

What is the Colorado Climate Center?

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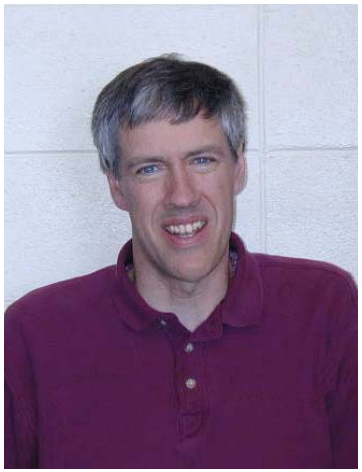


Mission

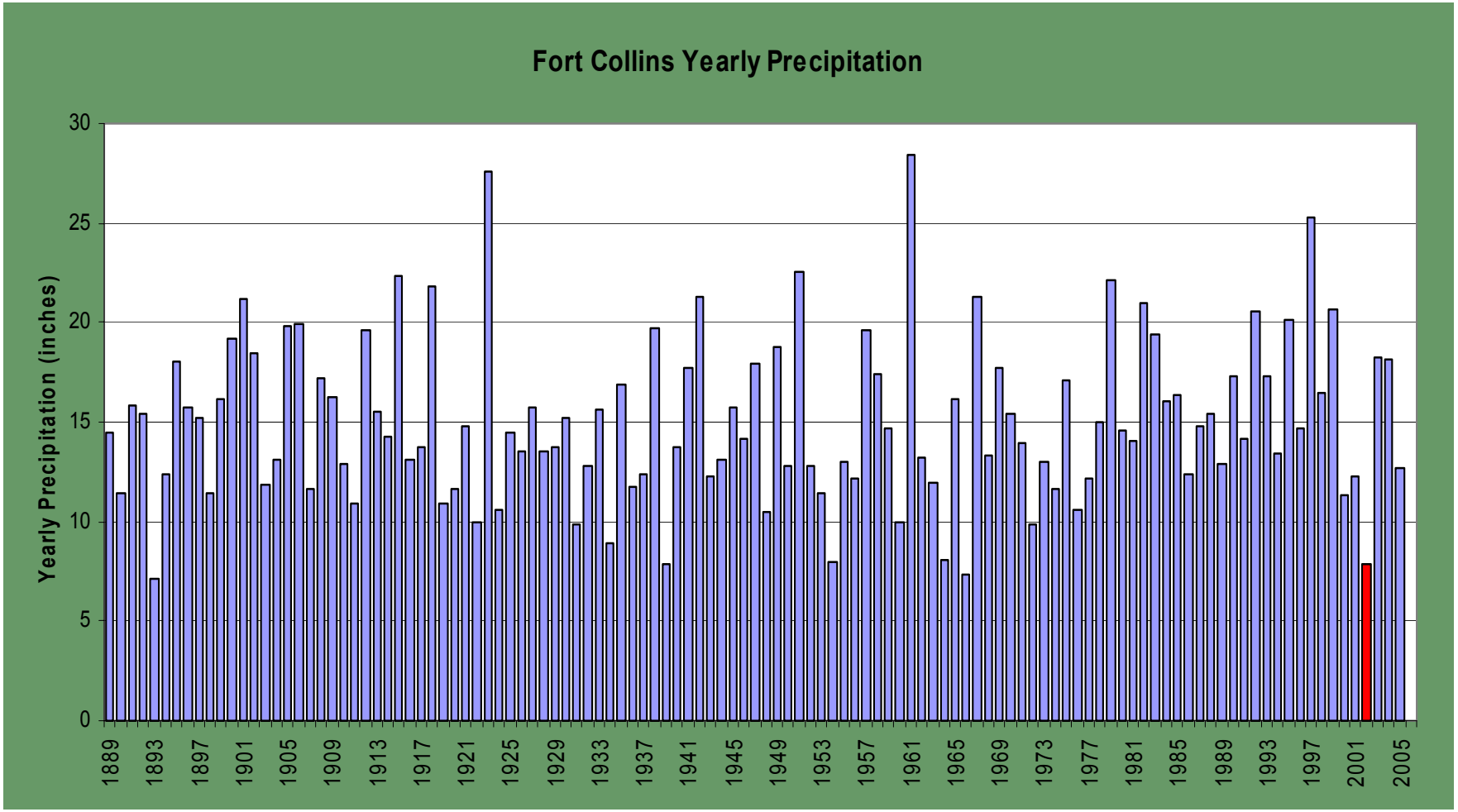
- The Colorado Climate Center was established by the state in 1974, through the Colorado State University Agricultural Experiment Station, to provide information and expertise on Colorado's complex climate. Through its threefold program of ***Climate Monitoring*** (data acquisition, analysis, and archiving), ***Climate Research*** and ***Climate Services***, the Center is responding to many climate related questions and problems affecting the state today.

What Does It Mean To "*Monitor*" ?

Fort Collins campus weather station

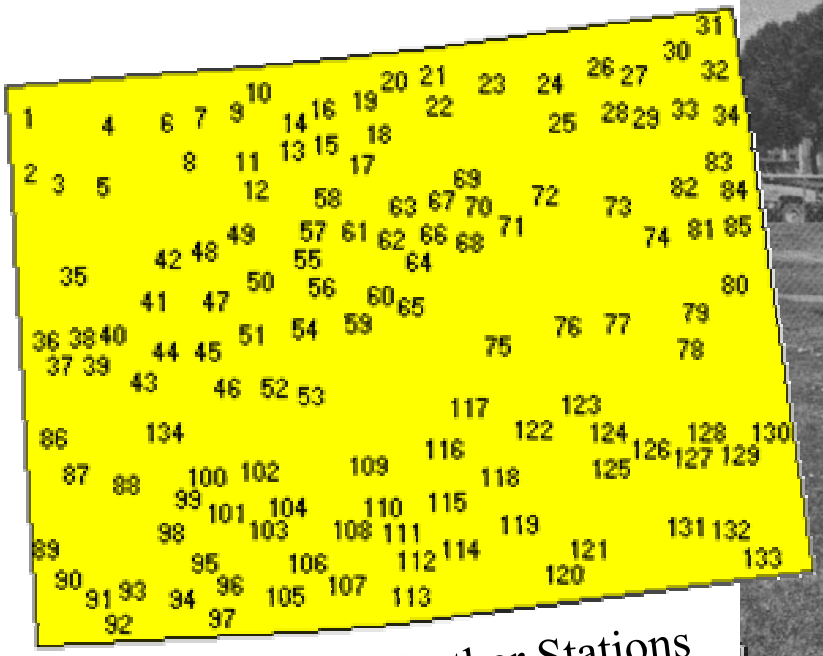
- Elements: temperature, precipitation, snow, wind, solar, evaporation, soil temperatures, humidity, cloud cover

Fort Collins Historic Weather Station – Continuous observations from 1889 to present



2005 totaled for Jan-Sep

National Weather Service Cooperative Weather Stations



Cooperative Weather Stations in Colorado

Typical Cooperative Weather Station

NCDC's Climatological Data publication for Colorado

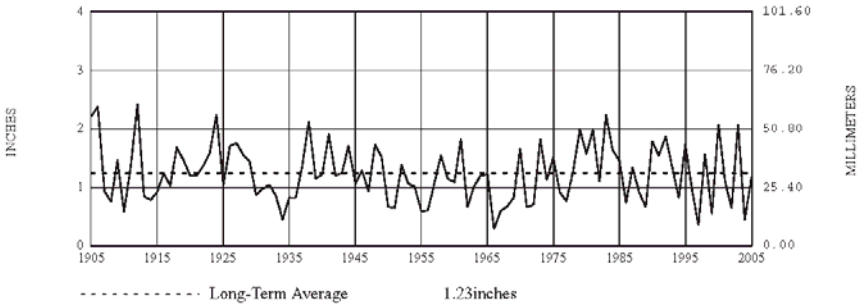
CLIMATOLOGICAL DATA

COLORADO

MARCH 2005

VOLUME 110 NUMBER 03

ISSN 0145-0506



COLORADO PRECIPITATION MARCH, 1905-2005

TEMPERATURE AND PRECIPITATION EXTREMES

HIGHEST TEMPERATURE	85	MARCH 12	LAS ANIMAS
LOWEST TEMPERATURE	-16	MARCH 15	2 STATIONS
GREATEST TOTAL PRECIPITATION	4.15		BONHAM RESERVOIR //
LEAST TOTAL PRECIPITATION	.03		CHEYENNE WELLS
GREATEST 1 DAY PRECIPITATION	1.55	MARCH 26	HAMILTON
GREATEST TOTAL SNOWFALL	53.8		WALSENBURG
GREATEST DEPTH OF SNOW OR ICE	97	MARCH 31	BONHAM RESERVOIR //

"I certify that this is an official publication of the National Oceanic and Atmospheric Administration (NOAA). It is compiled using information from weather observing sites supervised by NOAA/National Weather Service and received at the National Climatic Data Center (NCDC), Asheville, North Carolina 28801."

Thomas R. Karl

DIRECTOR
NATIONAL CLIMATIC DATA CENTER

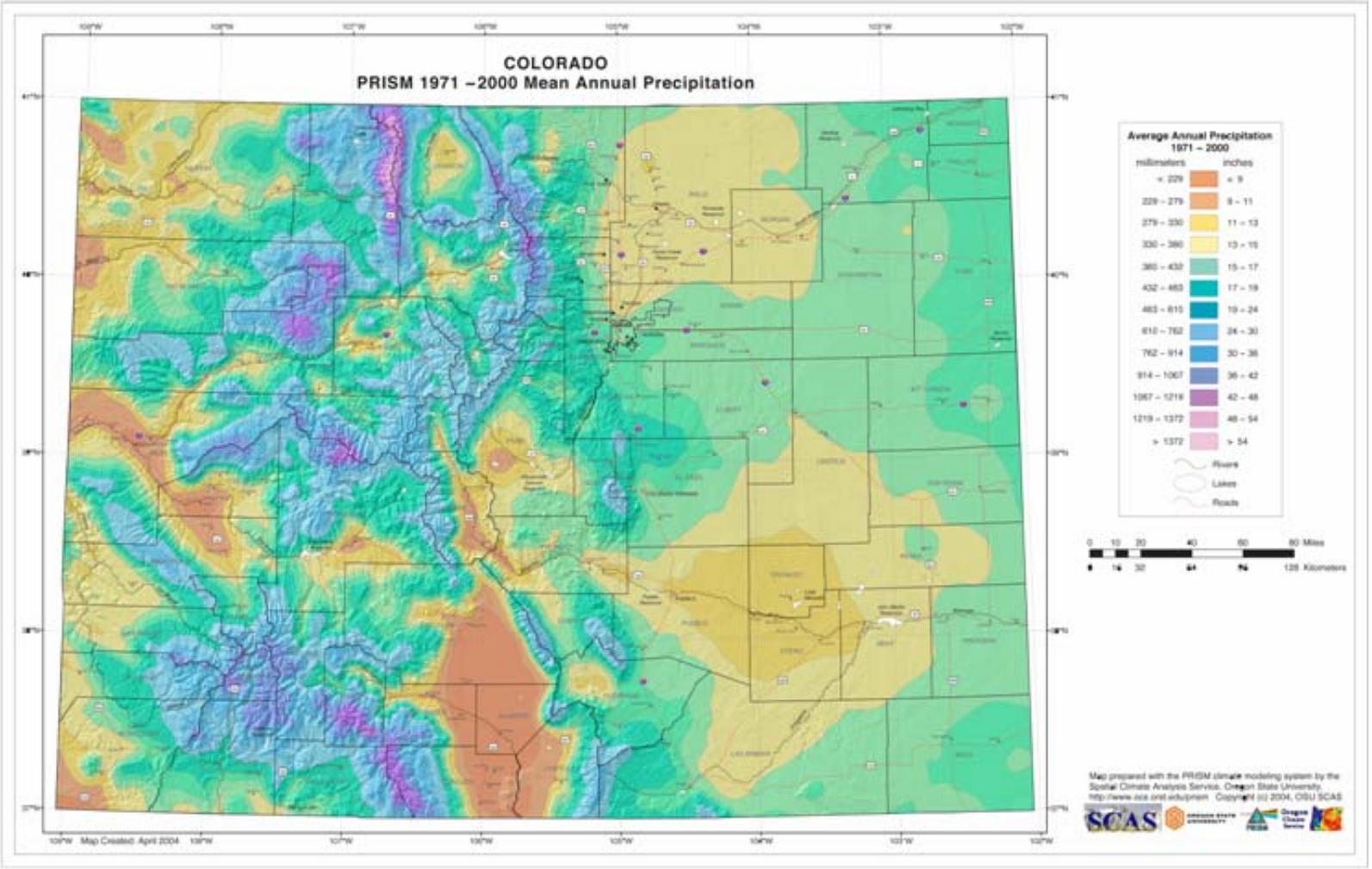
noaa

National Oceanic and Atmospheric Administration

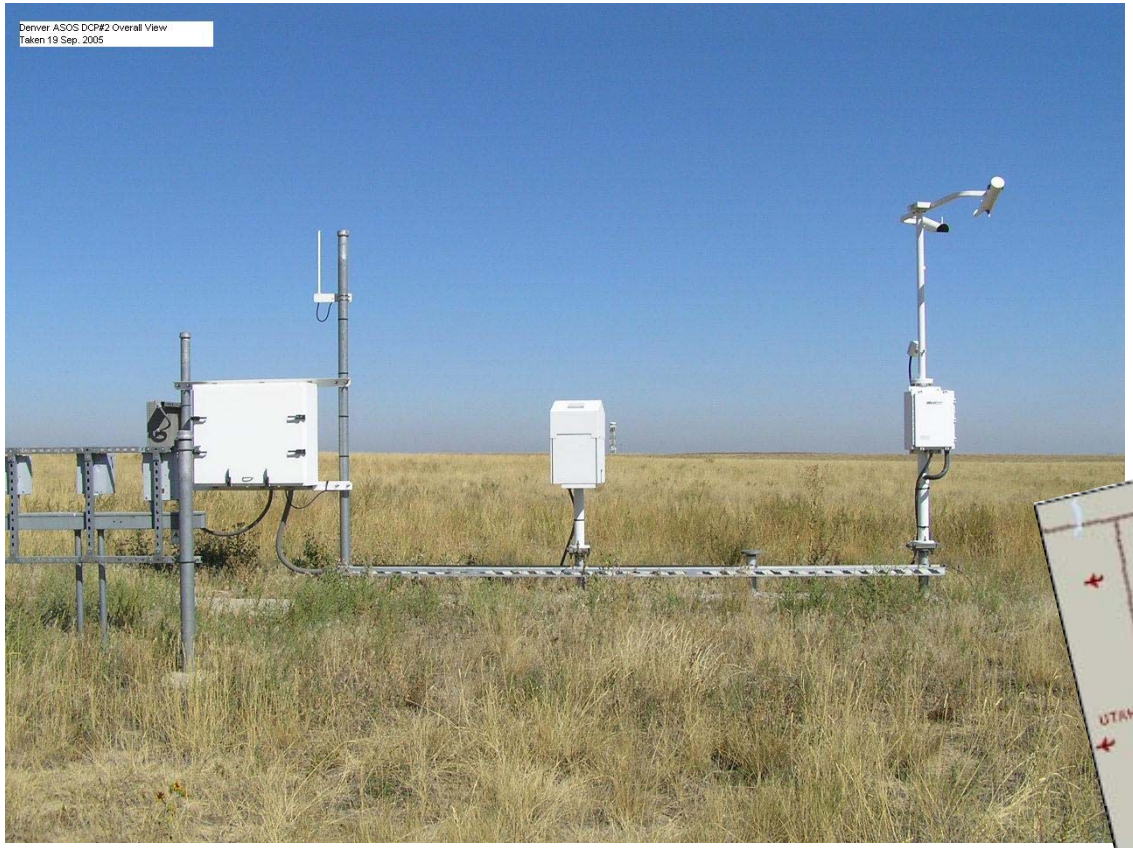
National Environmental Satellite, Data and Information Service

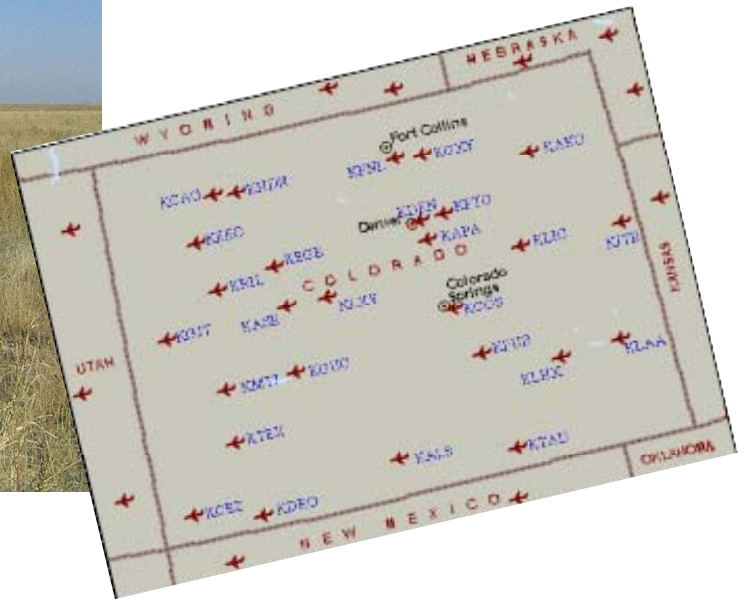
National Climatic Data Center Asheville, North Carolina

Colorado Average Annual Precipitation Map



National Weather Service Automated Surface Observing System (ASOS)





Denver International Airport ASOS,
Photo courtesy of the National Weather Service

Example F-6 form from Denver Intl Airport for July 2005

http://www.crh.noaa.gov/den/cli/climo.php

Preliminary Local Climatological Data (WS Form: F-6)...CORRECTED COOLING DEGREE DATA

Station: DENVER INTERNATIONAL AIRPORT Month: JULY Year: 2005

39.52N = Latitude 104.40W = Longitude Gnd Elev. 5431 ft Std Time: MDT

	Temperature in Fahrenheit						:Precip :	Snow		:Wind :	Fastest 2-Min:		Sunshine :	Sky		Peak Wind	
						Columns											
-1-	-2-	-3-	-4-	-5-	-6a-	-6b-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-
Day	Max	Min	Avg	Dep.	HDD	CDD	Water	Snow	Depth	Avg.	Speed	Dir	Mins.	%PSBL	SR-SS	Weather	Speed	Dir
1	91	52	72	0	0	7	0.00	M	M	9.2	23	270	698	78%		3	30	260
2	96	62	79	7	0	14	0.00	M	M	10.6	25	10	734	82%		3	30	10
3	90	55	73	1	0	8	T	M	M	10.9	41	260	561	63%			53	260
4	87	50	69	-3	0	4	0.00	M	M	9.5	32	20	787	88%			38	20
5	90	53	72	0	0	7	0.00	M	M	10.4	25	150	707	79%			32	170
6	94	54	74	2	0	9	0.00	M	M	8.3	23	190	780	87%			28	200
7	97	66	82	9	0	17	0.00	M	M	12.9	24	200	773	87%			30	190
8	97	70	84	11	0	19	T	M	M	11.5	26	190	598	67%		3	39	150
9	97	60	79	6	0	14	T	M	M	10.8	41	80	767	86%		3	54	70
10	98	58	78	5	0	13	0.00	M	M	10.4	24	330	804	91%			29	320
11	96	60	78	5	0	13	0.00	M	M	6.7	21	50	743	84%		8	24	40
12	95	64	80	7	0	15	0.00	M	M	10.8	23	100	761	86%			25	90
13	95	64	80	7	0	15	0.00	M	M	9.0	18	180	771	87%			23	180
14	98	65	82	8	0	17	0.00	M	M	11.7	26	310	651	74%			32	320
15	95	64	80	6	0	15	0.00	M	M	11.1	32	190	618	70%		3	36	190
16	102	61	82	8	0	17	0.00	M	M	9.8	21	210	745	85%			25	210
17	86	61	74	0	0	9	0.00	M	M	12.3	24	50	632	72%			28	30
18	89	55	72	-2	0	7	0.00	M	M	12.7	22	160	708	81%			32	140
19	101	65	83	9	0	18	0.00	M	M	11.2	17	10	811	92%			25	20
20	105	68	87	13	0	22	0.00	M	M	9.8	26	30	702	80%			31	30
21	104	67	86	12	0	21	0.00	M	M	12.2	24	30	793	91%			30	30
22	102	68	85	11	0	20	0.00	M	M	10.9	24	150	802	92%			32	130
23	102	63	83	9	0	18	0.09	M	M	10.7	33	300	651	75%		3	41	300
24	92	64	78	4	0	13	0.04	M	M	9.5	32	230	579	67%		3	37	240
25	88	59	74	0	0	9	0.06	M	M	11.0	35	330	625	72%		1	39	330
26	68	56	62	-12	3	0	0.08	M	M	9.1	22	50	470	54%		1,2	24	50
27	86	54	70	-4	0	5	0.00	M	M	8.2	22	200	814	94%		2,1	25	200
28	95	52	74	0	0	9	0.00	M	M	9.3	22	200	821	95%			25	200
29	99	67	83	9	0	18	0.00	M	M	11.1	25	200	821	95%			39	200
30	101	68	85	11	0	20	0.00	M	M	11.7	31	120	737	86%			38	110
31	94	60	77	3	0	12	0.00	M	M	8.2	30	200	678	79%			36	200
Sum	2930	1885			3	405	0.27	0.0	0	321.5			22142					
Avg	94.5	60.8								10.4	Fast	Dir	27263	81%			Max	Dir.
											41	80					54	70

NOTE: SNOWFALL AND SUNSHINE DATA MEASURED BY COOP OBSERVERS AT THE FORMER STAPLETON INTERNATIONAL AIRPORT.

[Temperature Data]

Average Monthly: 77.7
Departure from Normal: +4.3
Highest: 105 on 20
Lowest: 50 on 4

Records:
8-Rec high min 70 old 68 last 1989
16-Rec high 102 old 101 last 2003
19-Rec high 101 old 100 last 1934
20-Rec high 105 old 102 last 1939 (Ties Denver's hottest temperature ever)
21-Rec high 104 old 100 last 1981
22-Rec high 102 old 100 last 1931
23-Rec high 102 old 101 last 1910
29-Tied Rec high 99 last 1995
30-Rec high 101 old 100 last 1972 (Most 100 degree days in a month or season)
July 2005 2nd hottest and 3rd driest

[Precipitation Data]

Total for Month: 0.27
Departure from Normal: -1.89
Greatest in 24 hrs: 0.14 on 25-26

SNOWFALL, ICE PELLETS, HAIL
Total for month: 0.0 inches
Greatest snowfall in 24 hrs: N on N
Greatest snow depth: 0 on 1

Symbols used in column 16

1 = Fog
2 = Fog reducing visibility to 1/4 mile or less
3 = Thunder
4 = Ice Pellets
5 = Hail
6 = Glaze or Rime
7 = Blowing dust or sand reducing visibility to 1/2 mile or less
8 = Smoke or haze
9 = Blowing snow
X = Tornado

[No. days with]

Max 32 or below: 0
Max 90 or above: 25
Min 32 or below: 0
Min 0 or below: 0

[WEATHER -No. days with]

0.01 inch or more precip: 4
0.10 inch or more precip: 0
0.50 inch or more precip: 0
1.00 inch or more precip: 0

[Heating Degree Days (Base 65)]

Total this month: 3
Departure from Normal: +2
Seasonal Total: 3
Departure from Normal: +2

[Cooling Degree Days (Base 65)]

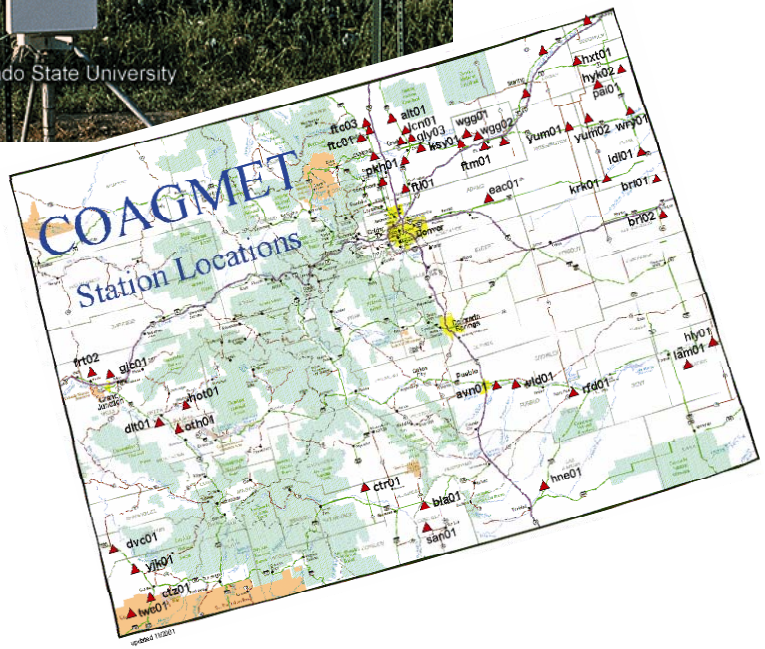
Total this Month: 405
Departure from Normal: +136
Seasonal Total: 558
Departure from Normal: -136

[Pressure Data]

Highest Sea-Level 30.25 on 26
Lowest Sea-Level 29.61 on 2

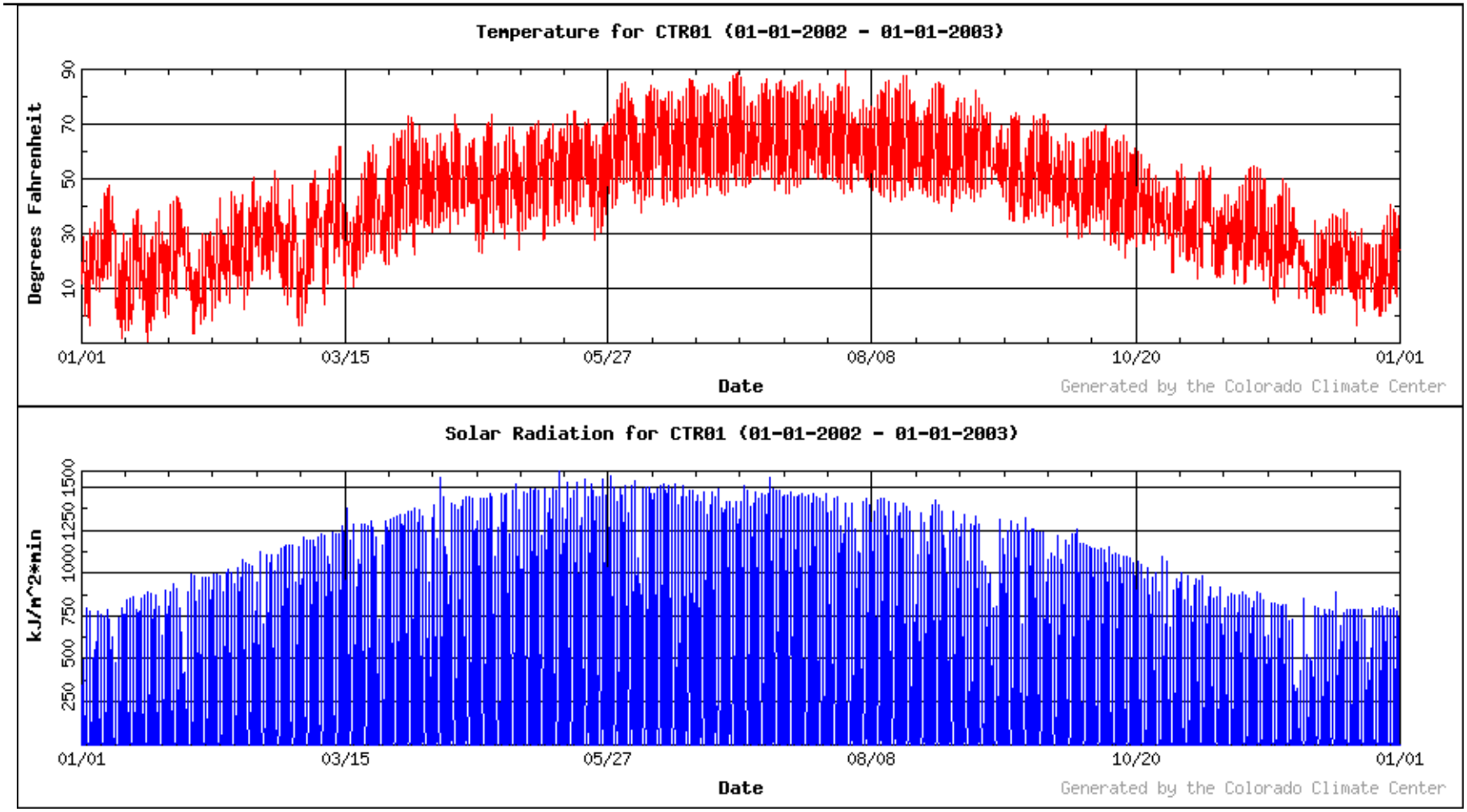
CoAgMet
Weather Data for Agriculture

- Automated weather stations with daily and hourly readings of:
  - Temperature
  - Humidity
  - Wind
  - Precipitation
  - Solar energy
  - Evapotranspiration

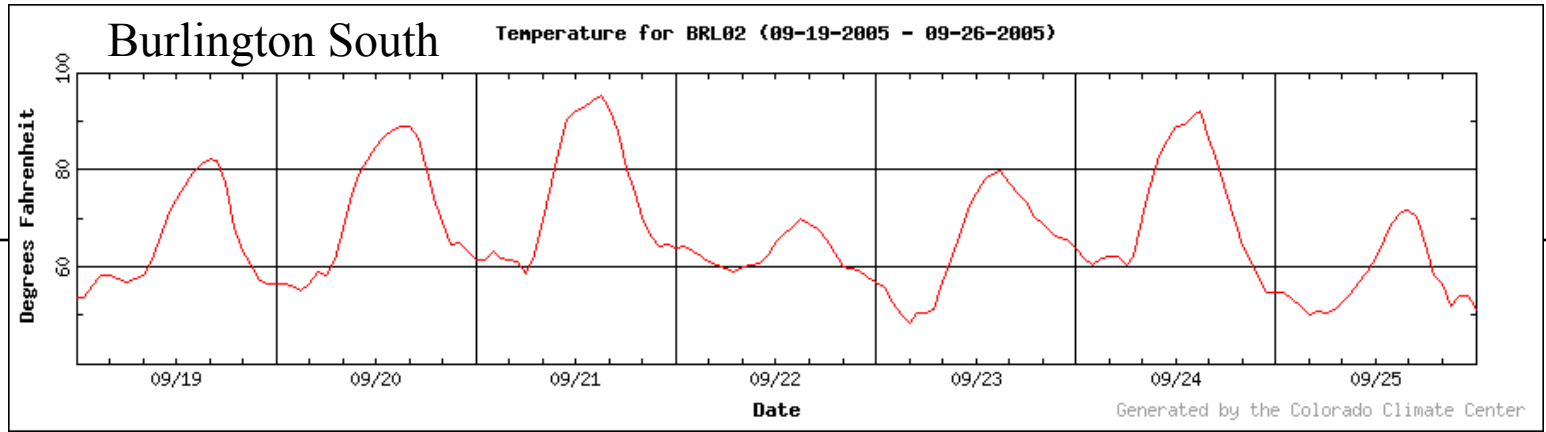


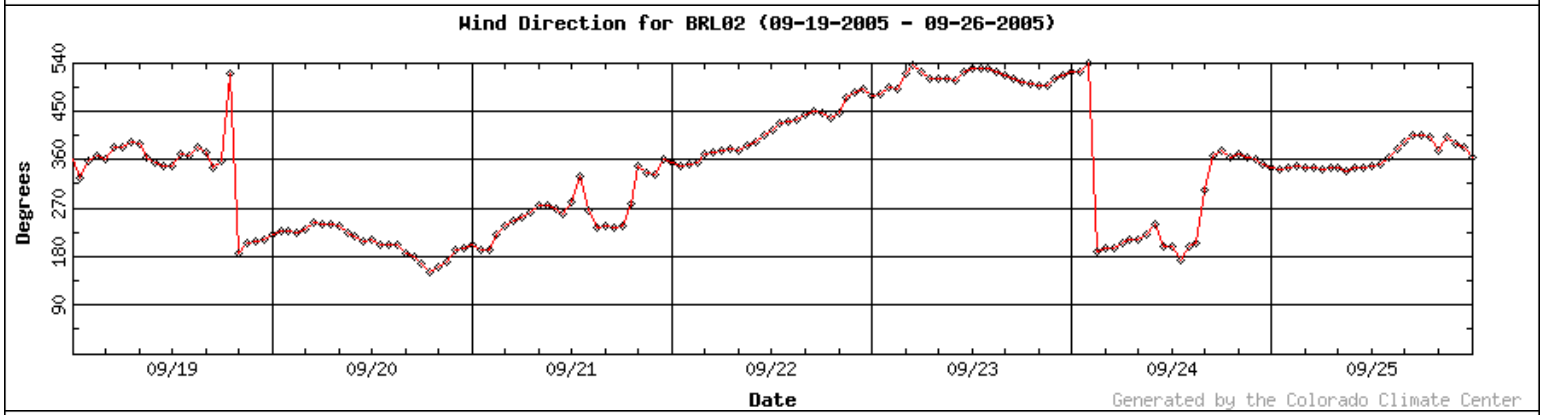
http://www.coagmet.com

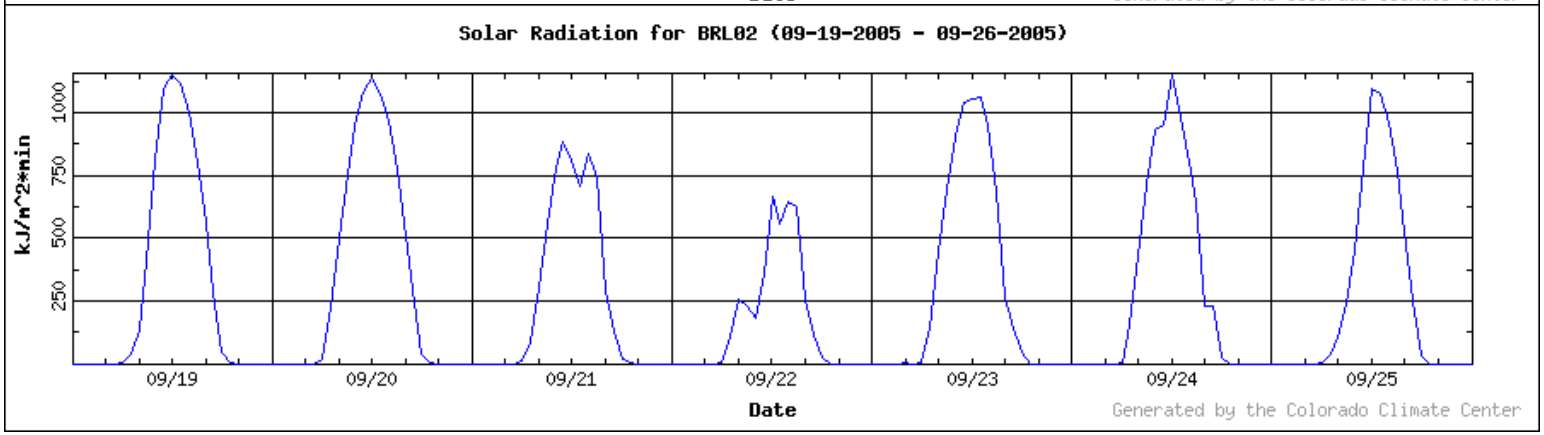
Center, Colo., CoAgMet Daily Values of Temperature and Solar Radiation



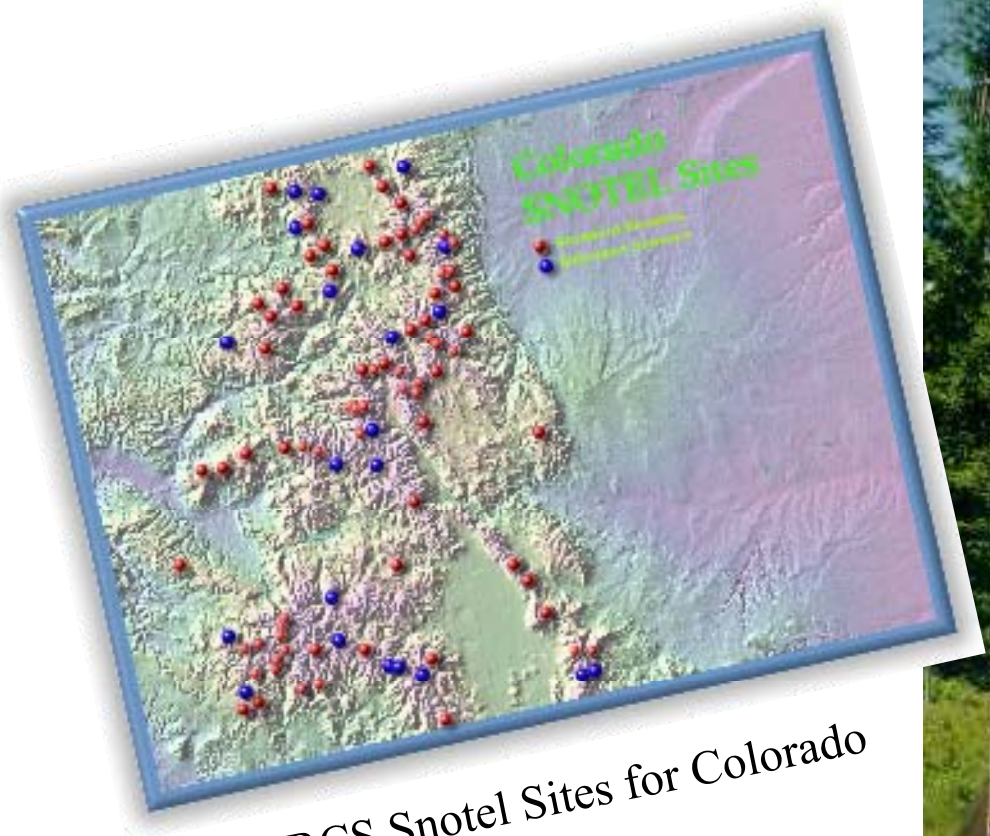
Burlington South







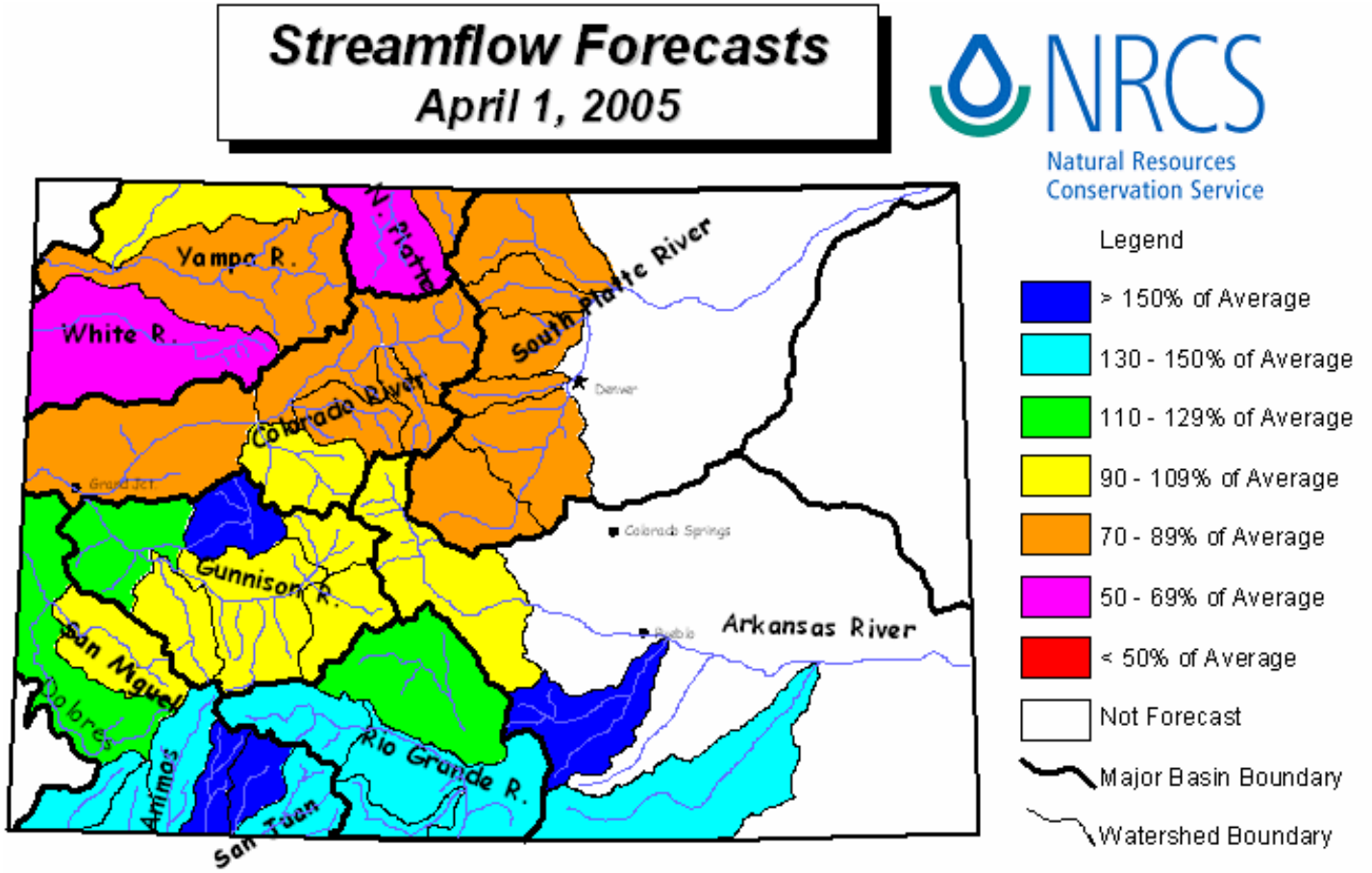
USDA, Natural Resources Conservation Service



NRCS Snotel Sites for Colorado

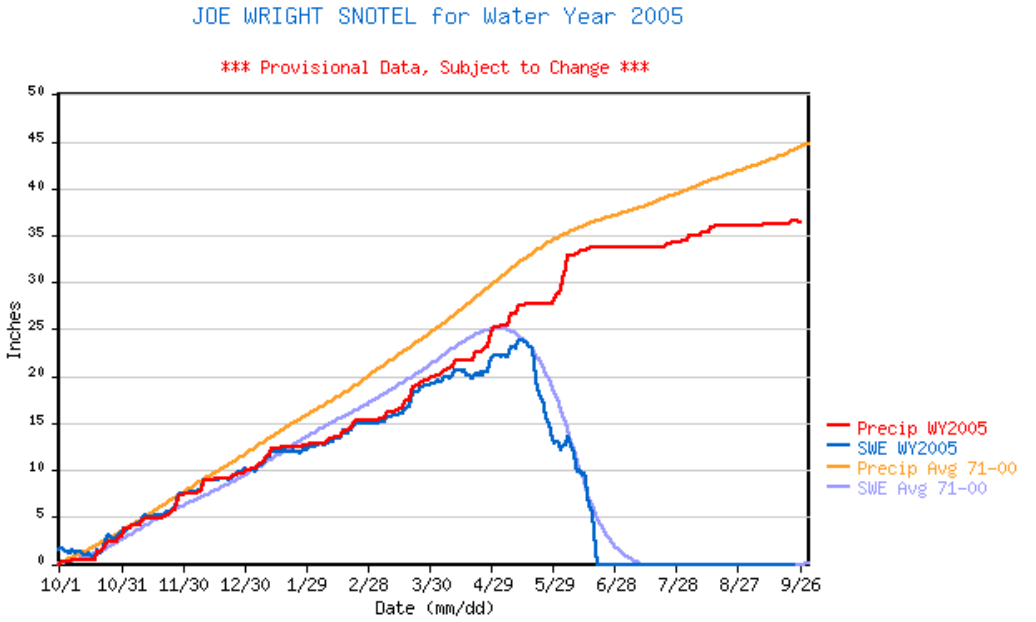
Typical NRCS Snotel Site

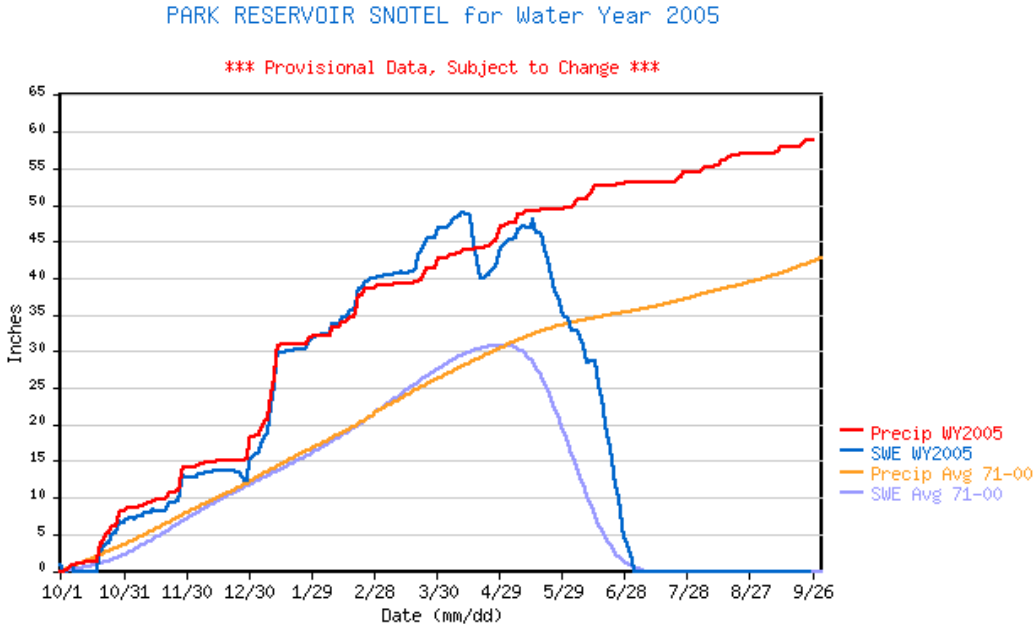
NRCS Streamflow Forecast



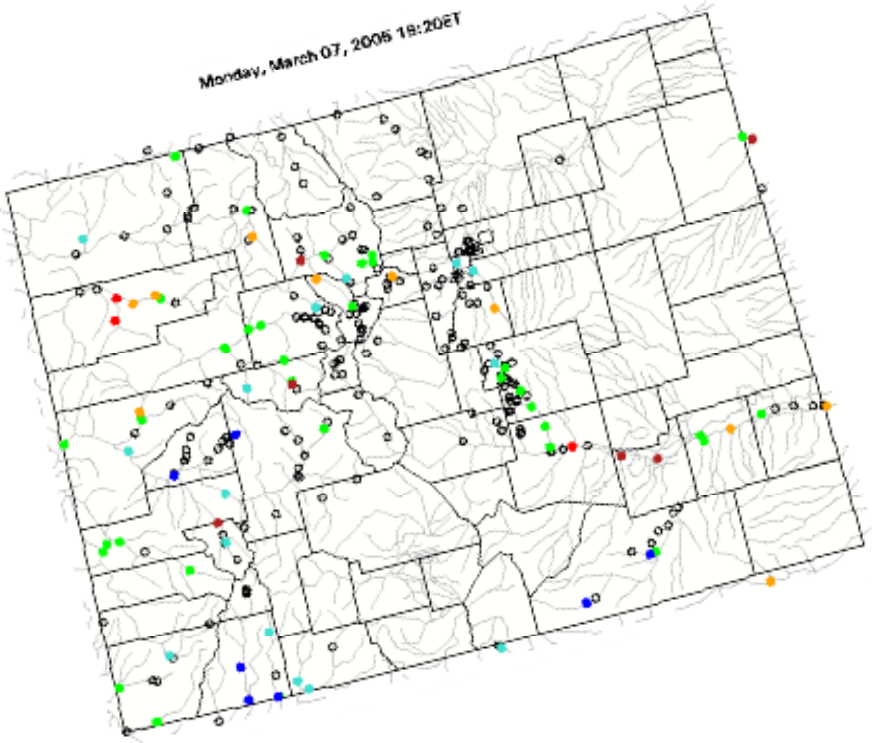
http://www.co.nrcs.usda.gov/snow/watersupply/

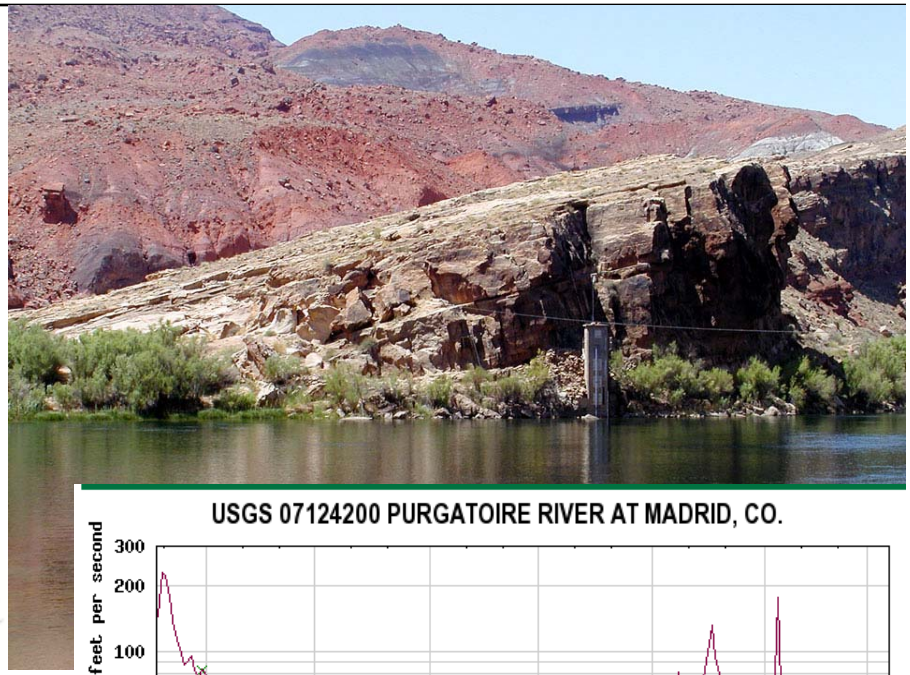
Snotel Data WY2005

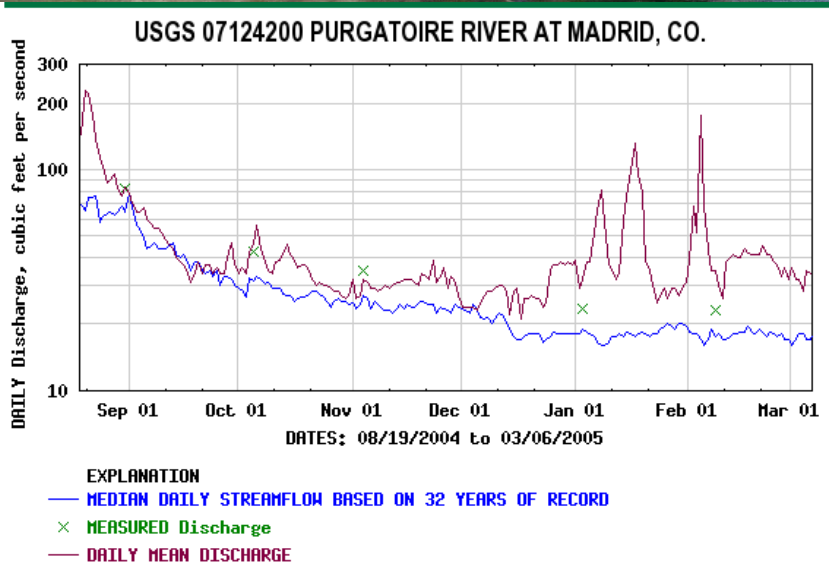




U.S. Geological Survey



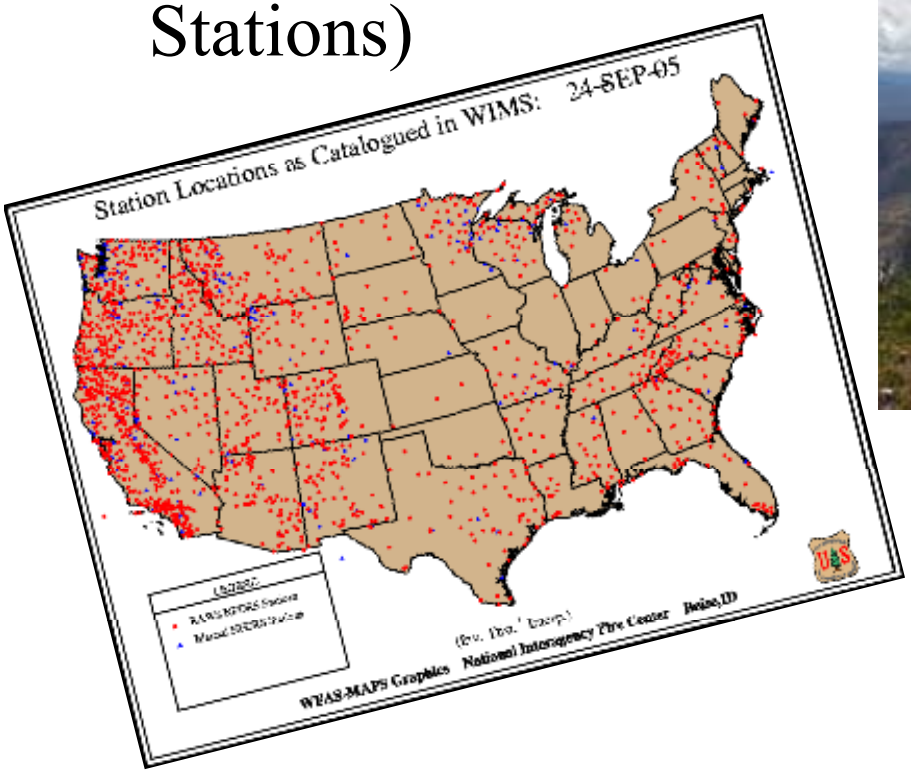




http://water.usgs.gov/waterwatch/

Other Data Sources

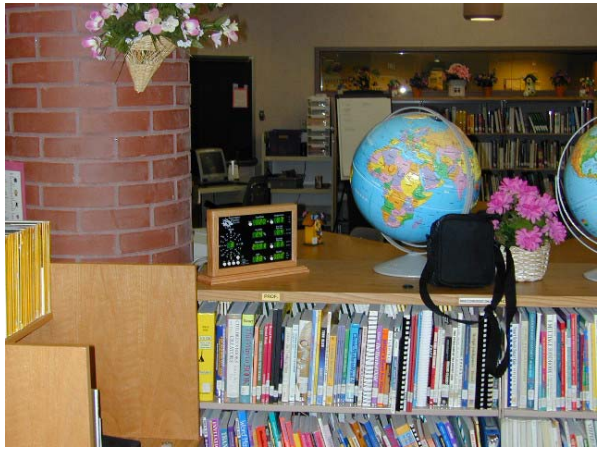
- RAWS (Remote Automated Weather Stations)



Storm King RAWS

http://www.fs.fed.us/raws/

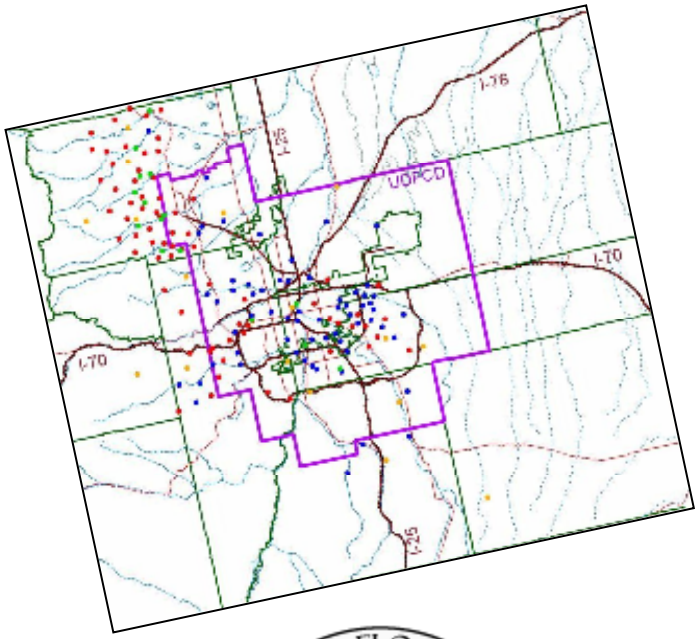
School Weather Stations



Colorado Department of Transportation (CDOT)

Colorado Department of Transportation

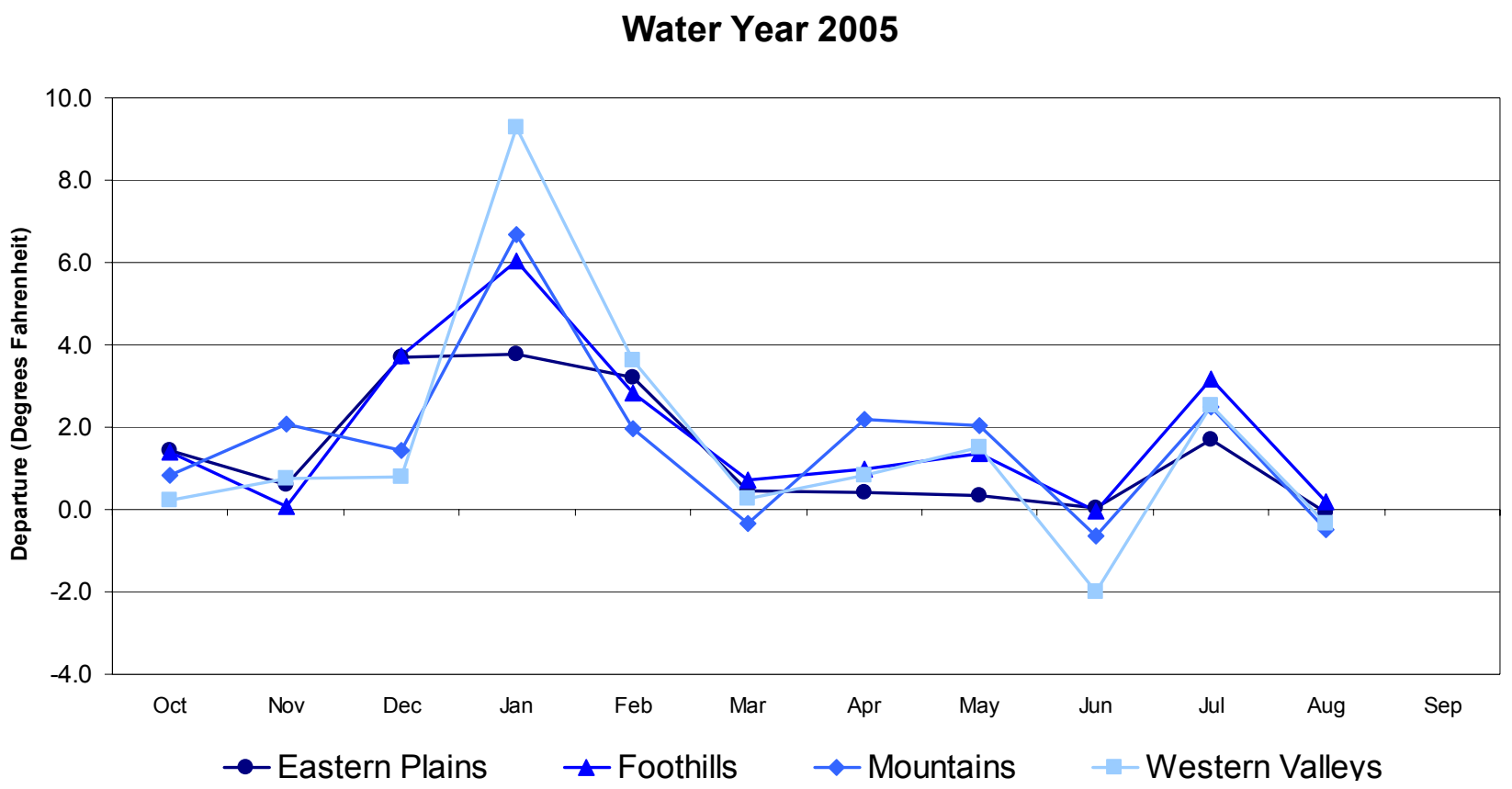
Urban Drainage and Flood Control District (UDFCD) ALERT system



New ALERT weather station & stream gauge on Marston Lake North Drainageway.

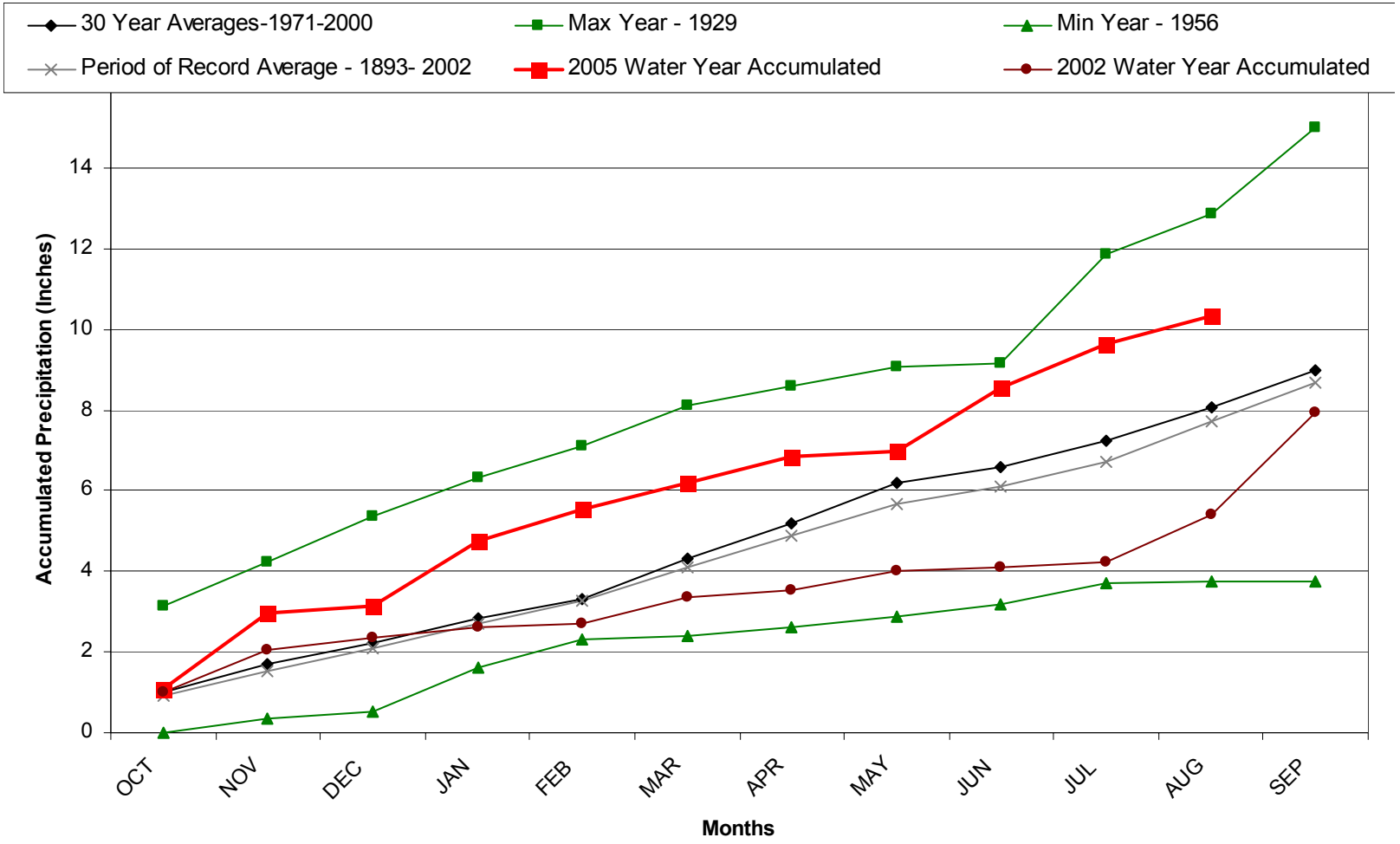
What Is Our Current Status?

Colorado Temperature Departures

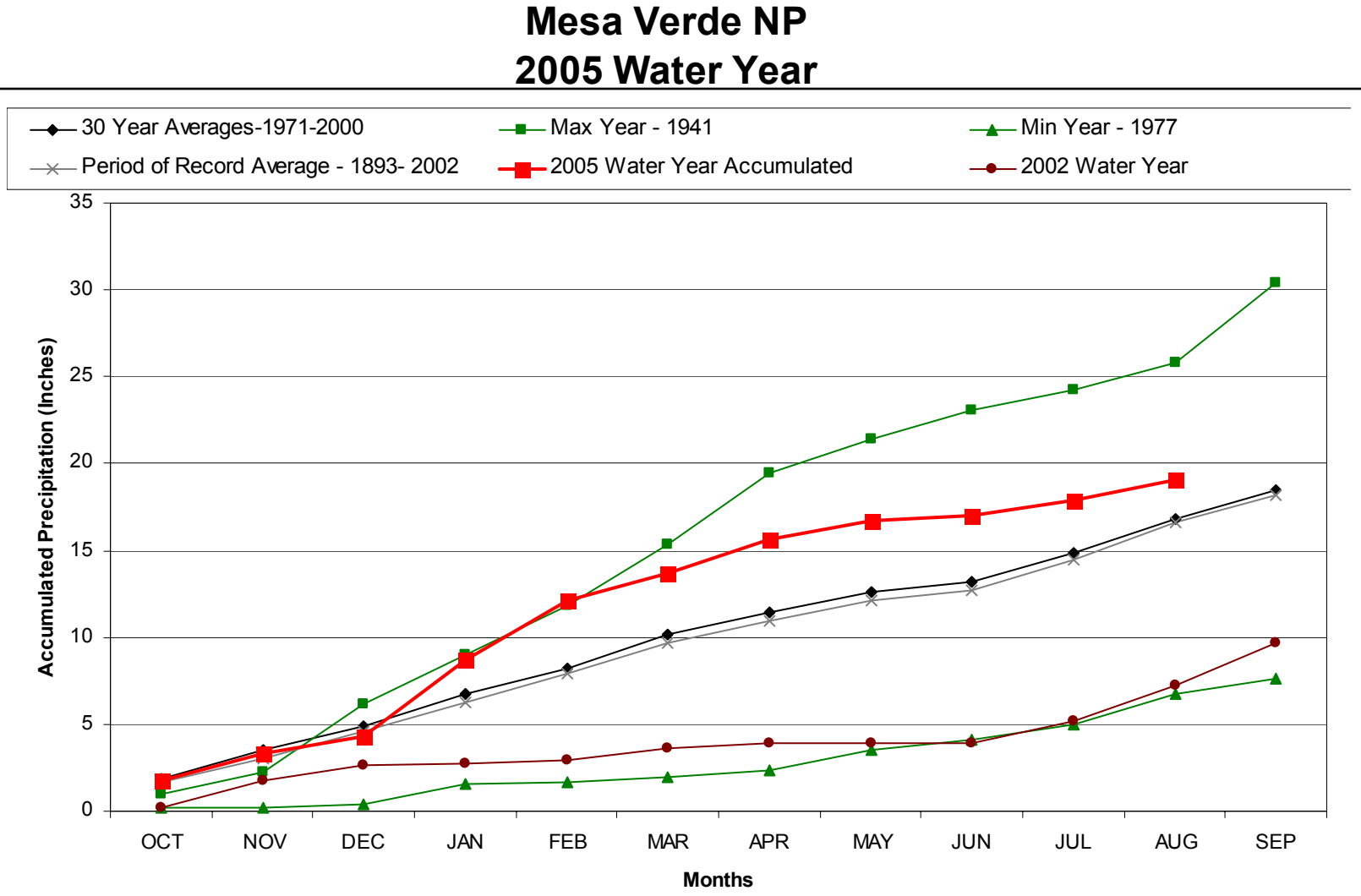


Division 2 – Grand Junction

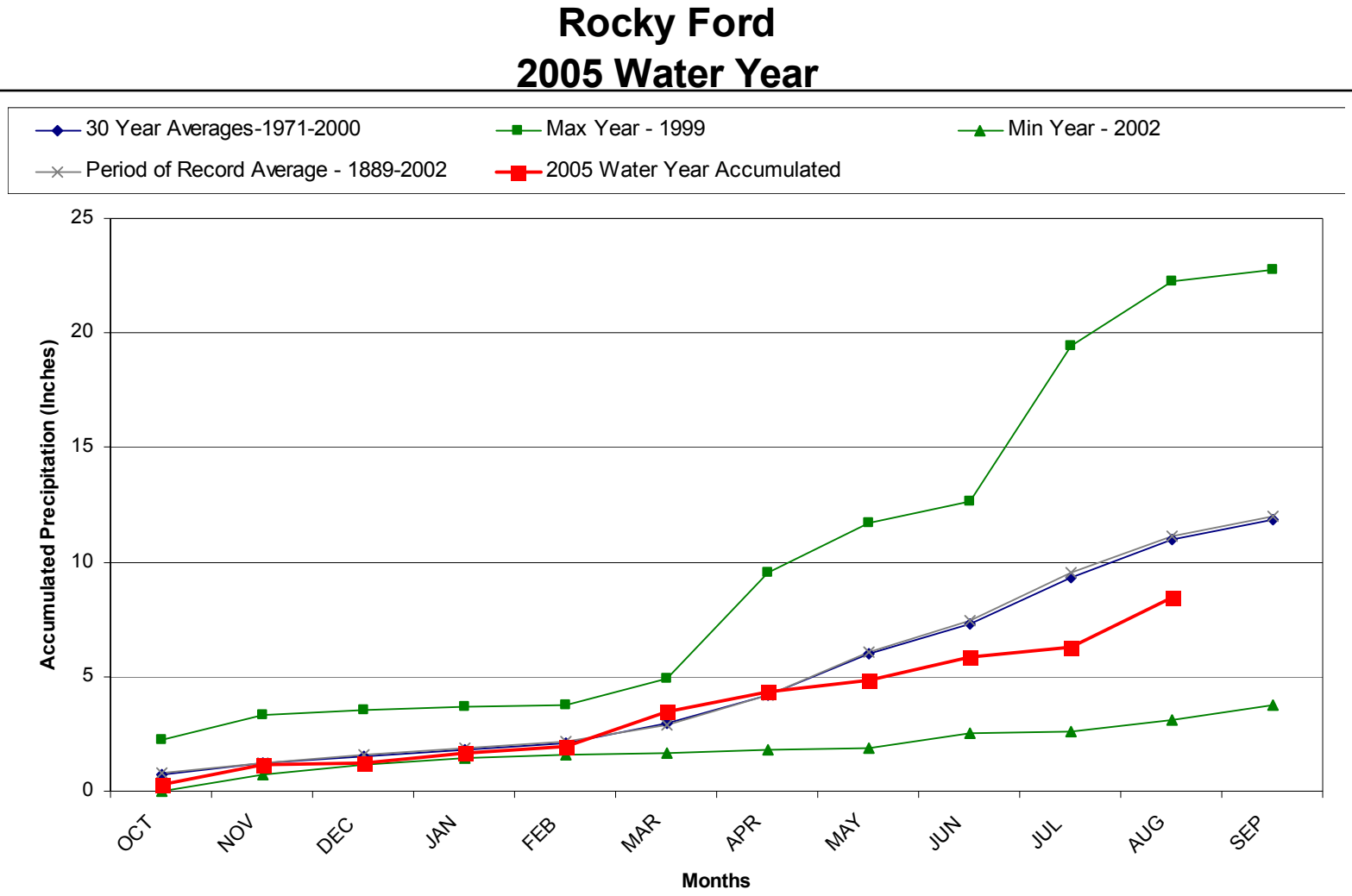
Grand Junction WSFO
2005 Water Year



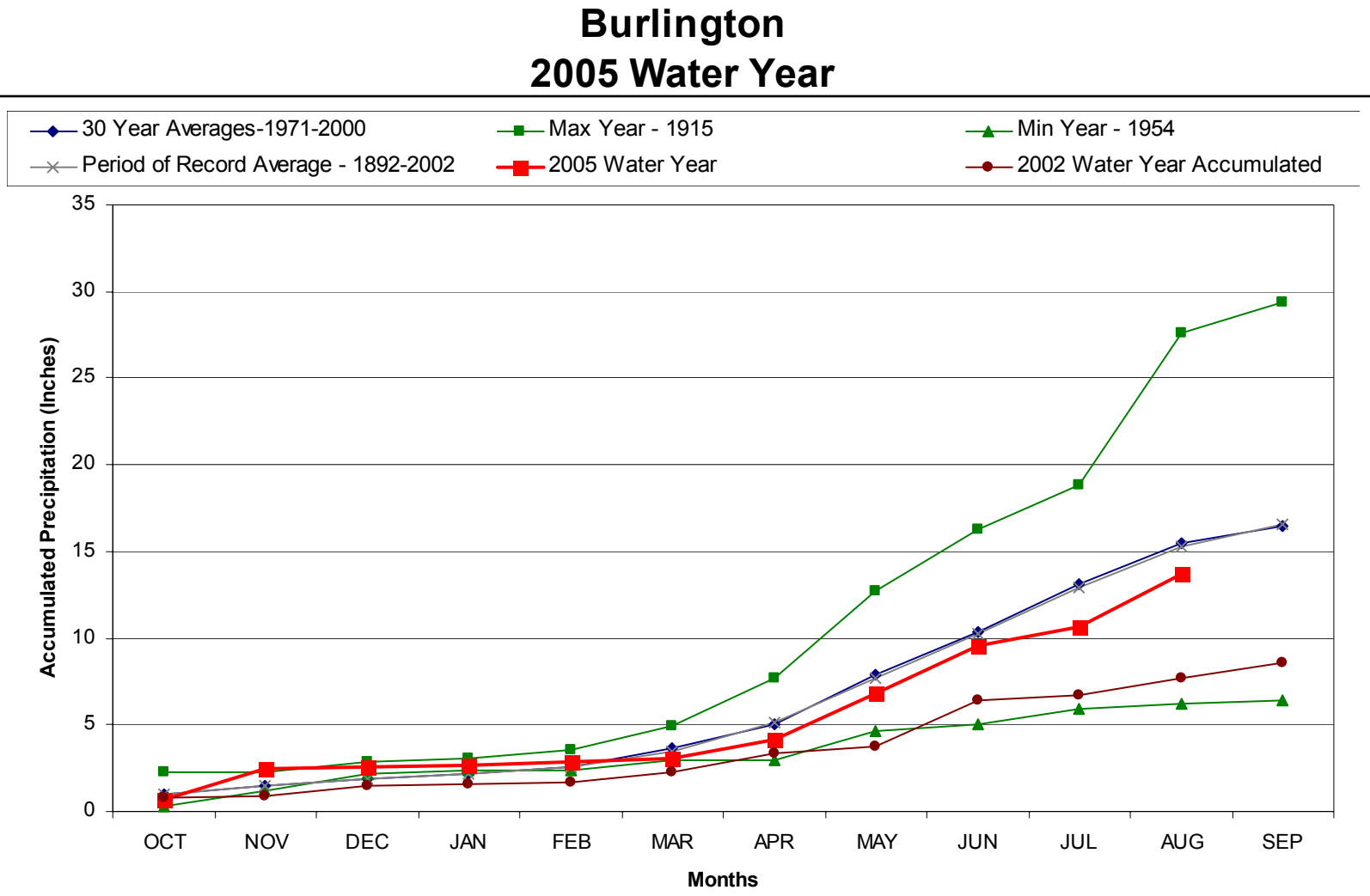
Division 3 – Mesa Verde



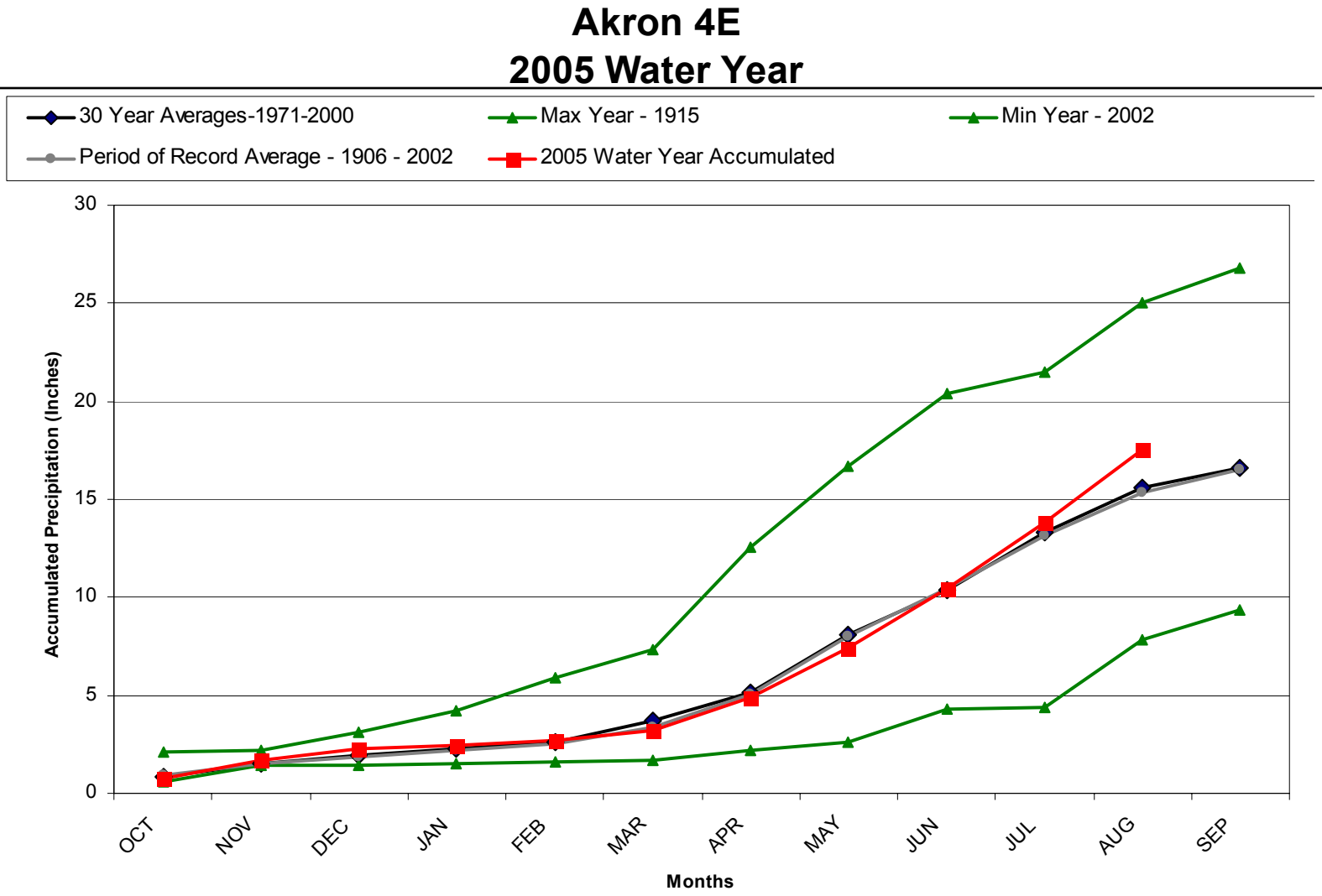
Division 6 - Rocky Ford



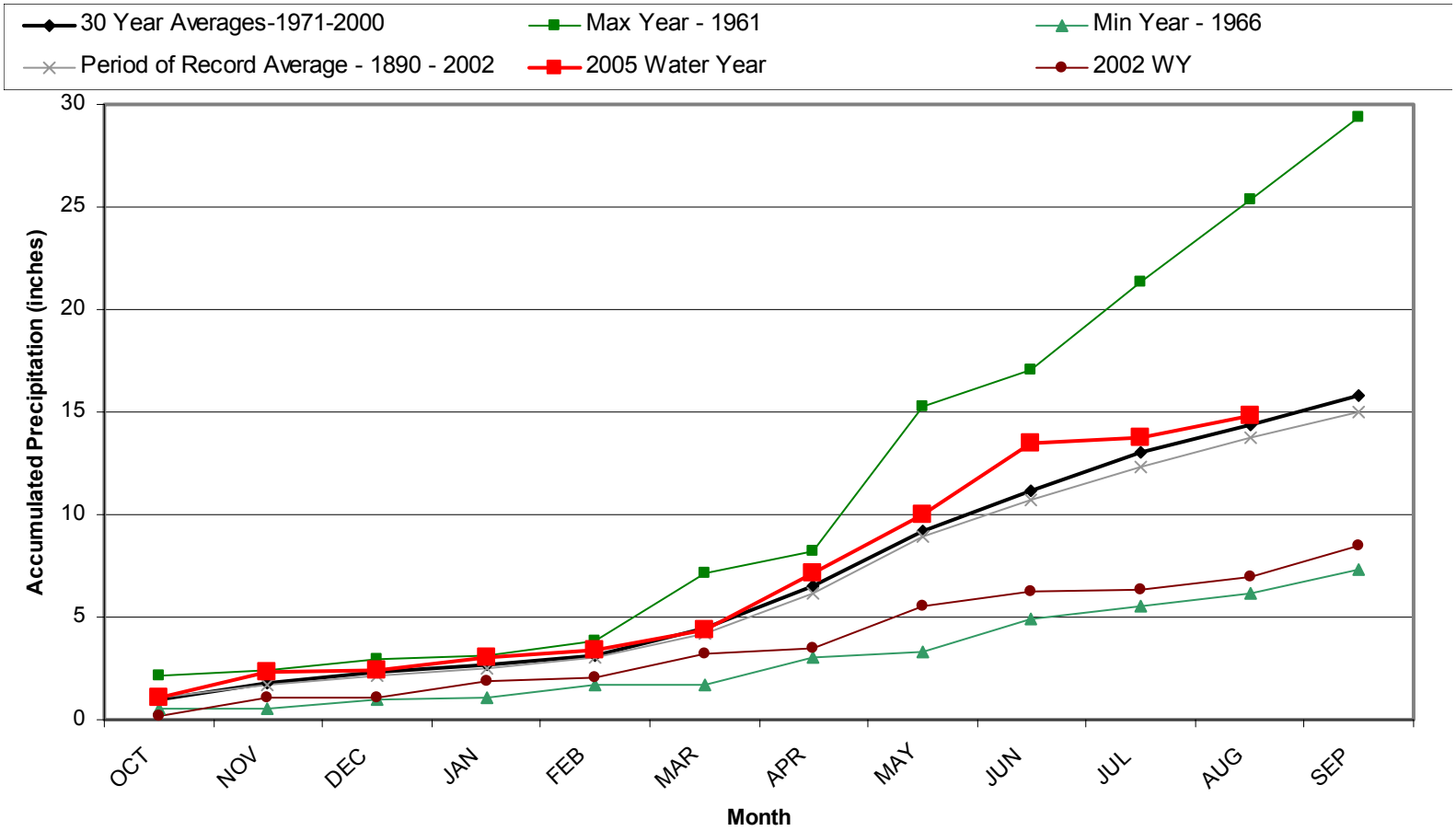
Division 7 – Burlington



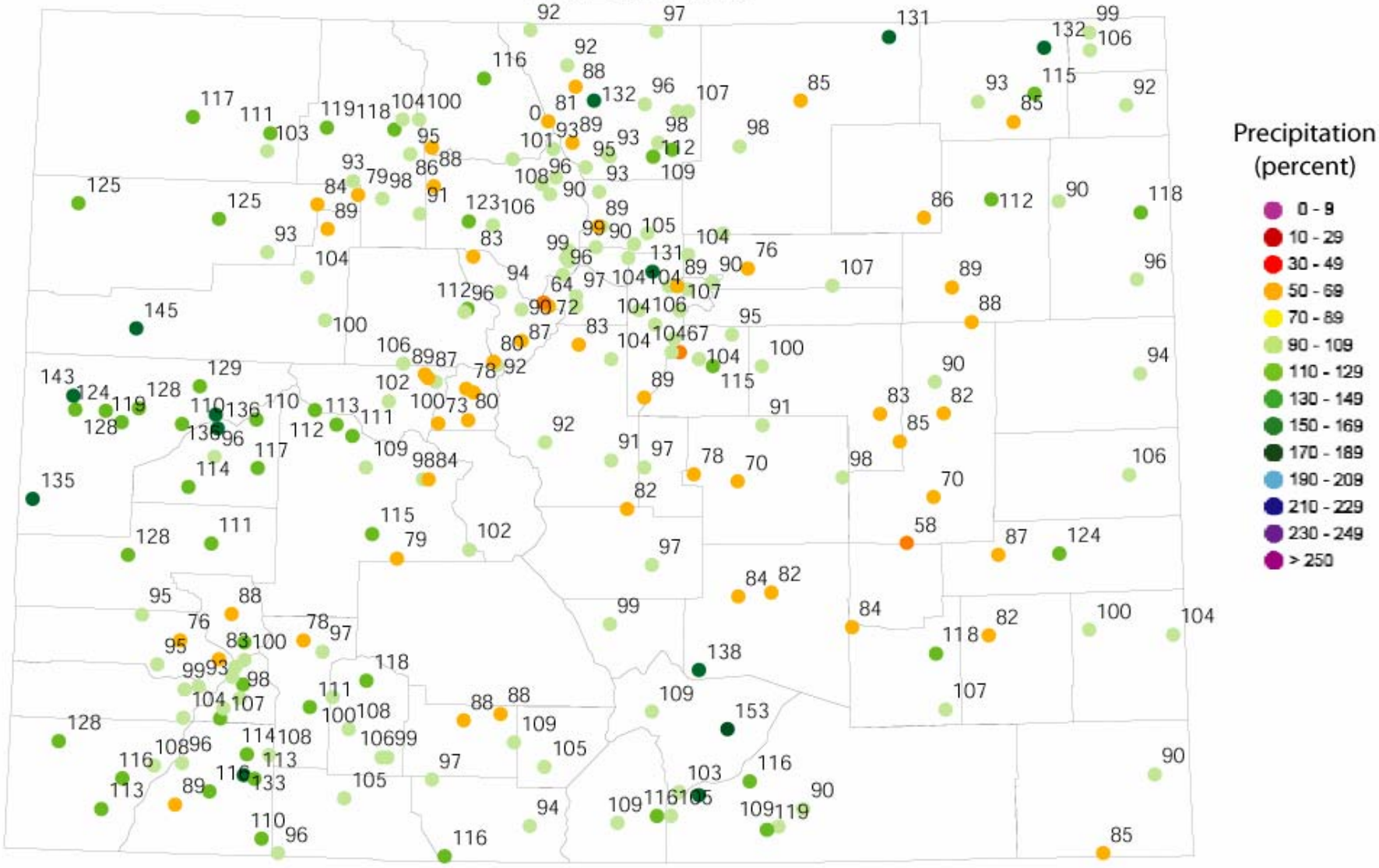
Division 7 – Akron



Division 8 – Fort Collins



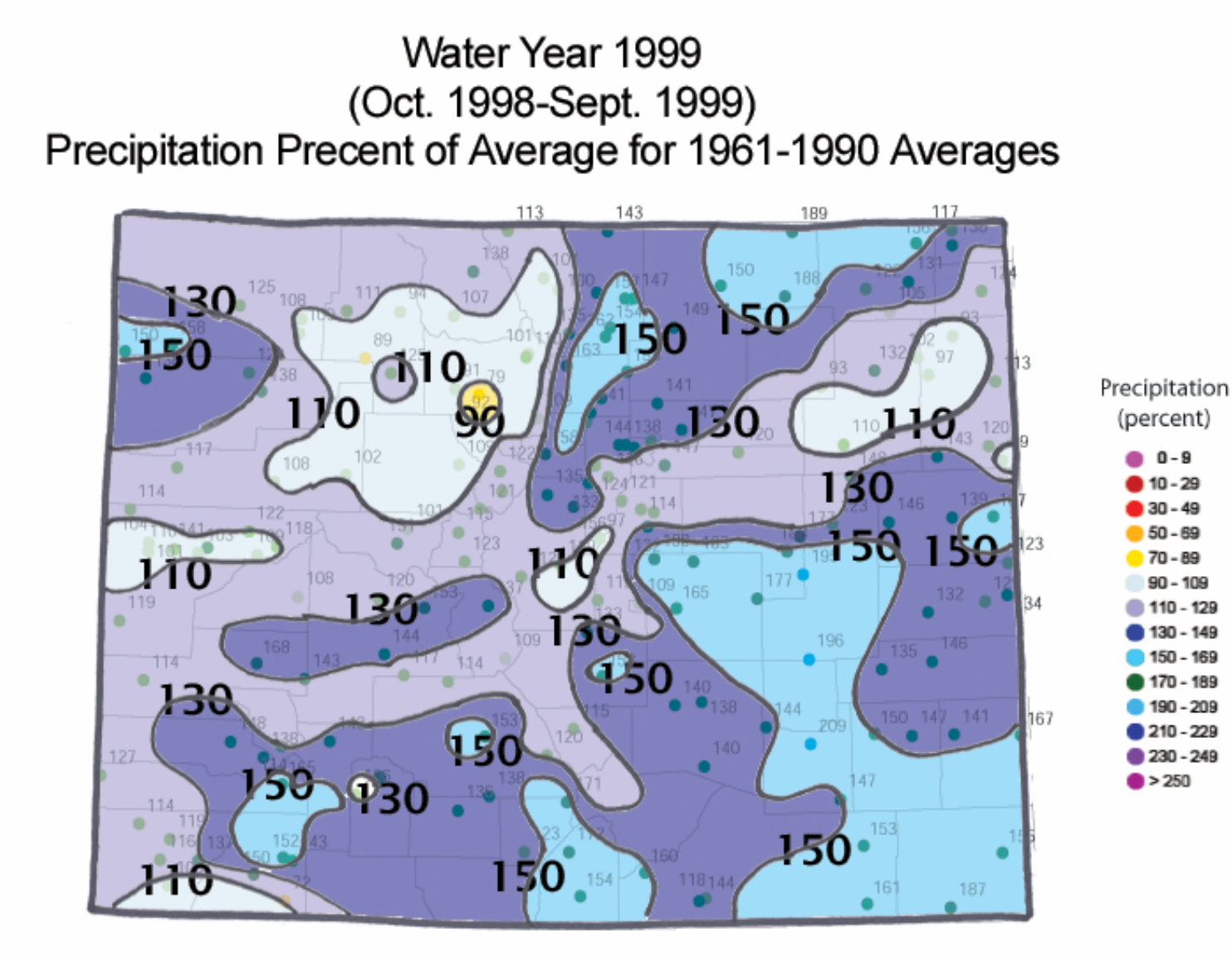
COLORADO



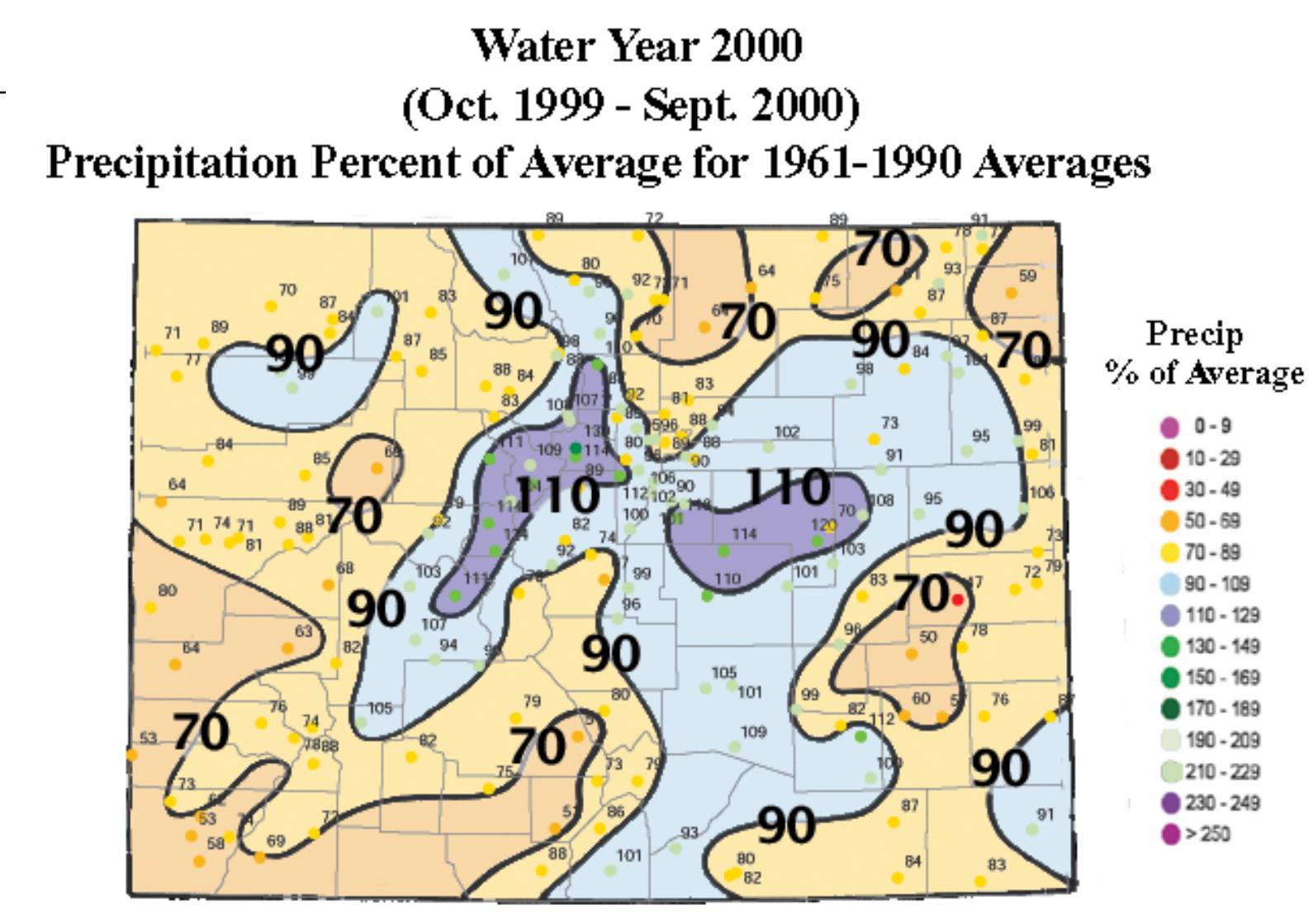
Water Year 2005 (October 2004 through August 2005) precipitation as a percent of the 1971-2000 average.

Current Conditions Compared to Recent Years

1999 Water Year Precipitation



2000 Water Year Precipitation

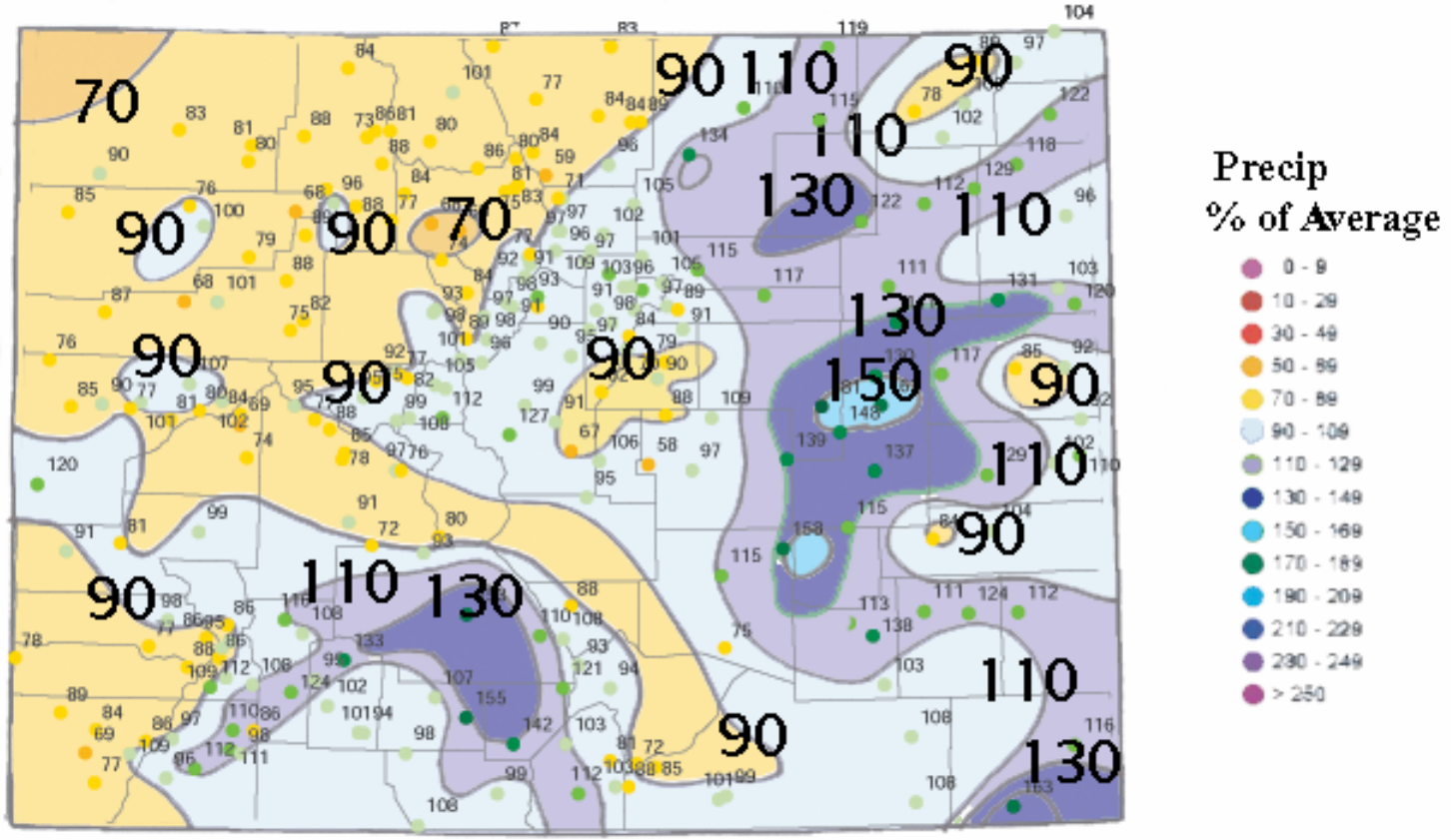


2001 Water Year Precipitation

Water Year 2001

(Oct. 2000 - Sept. 2001)

Precipitation Percent of Average for 1961-1990 Averages

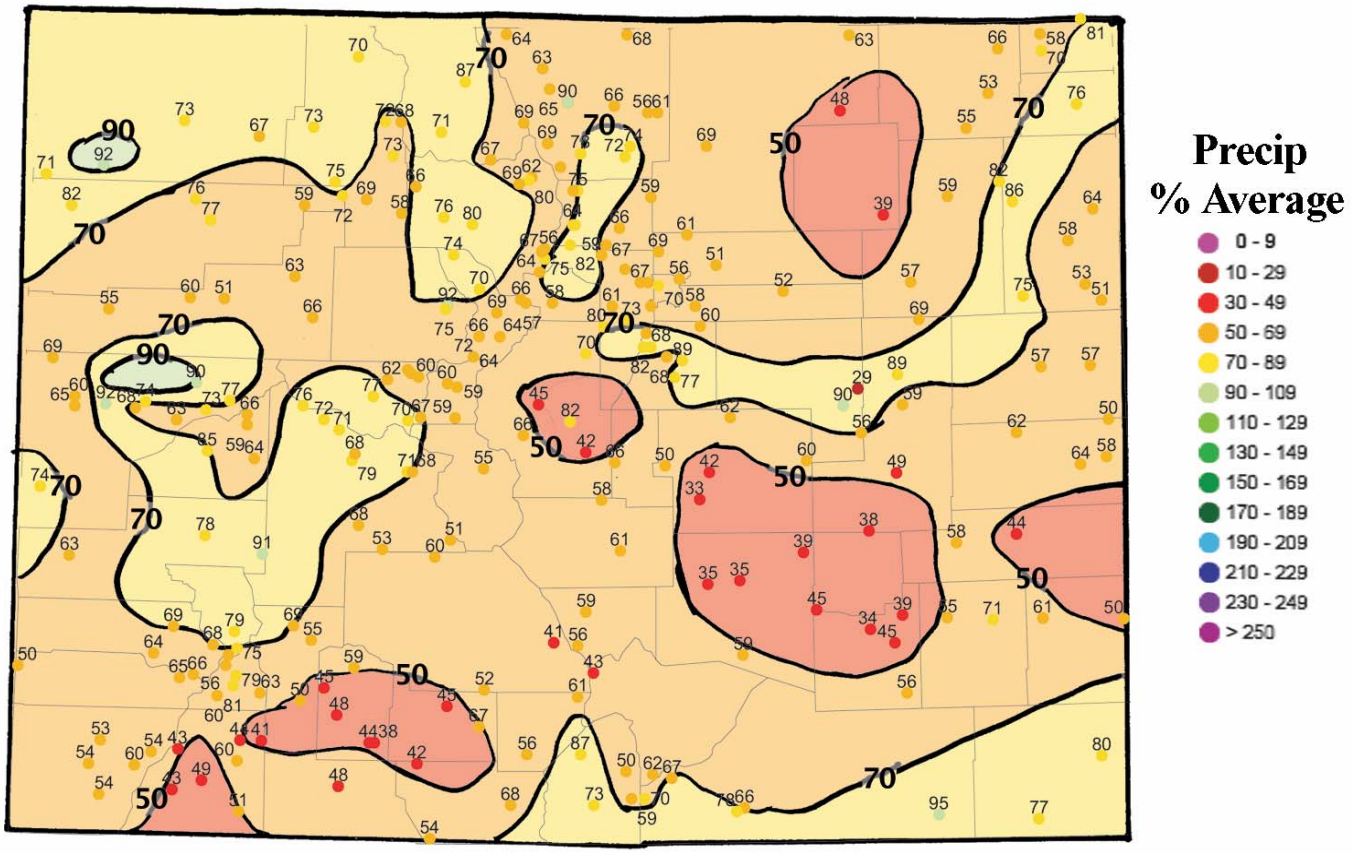


2002 Water Year Precipitation

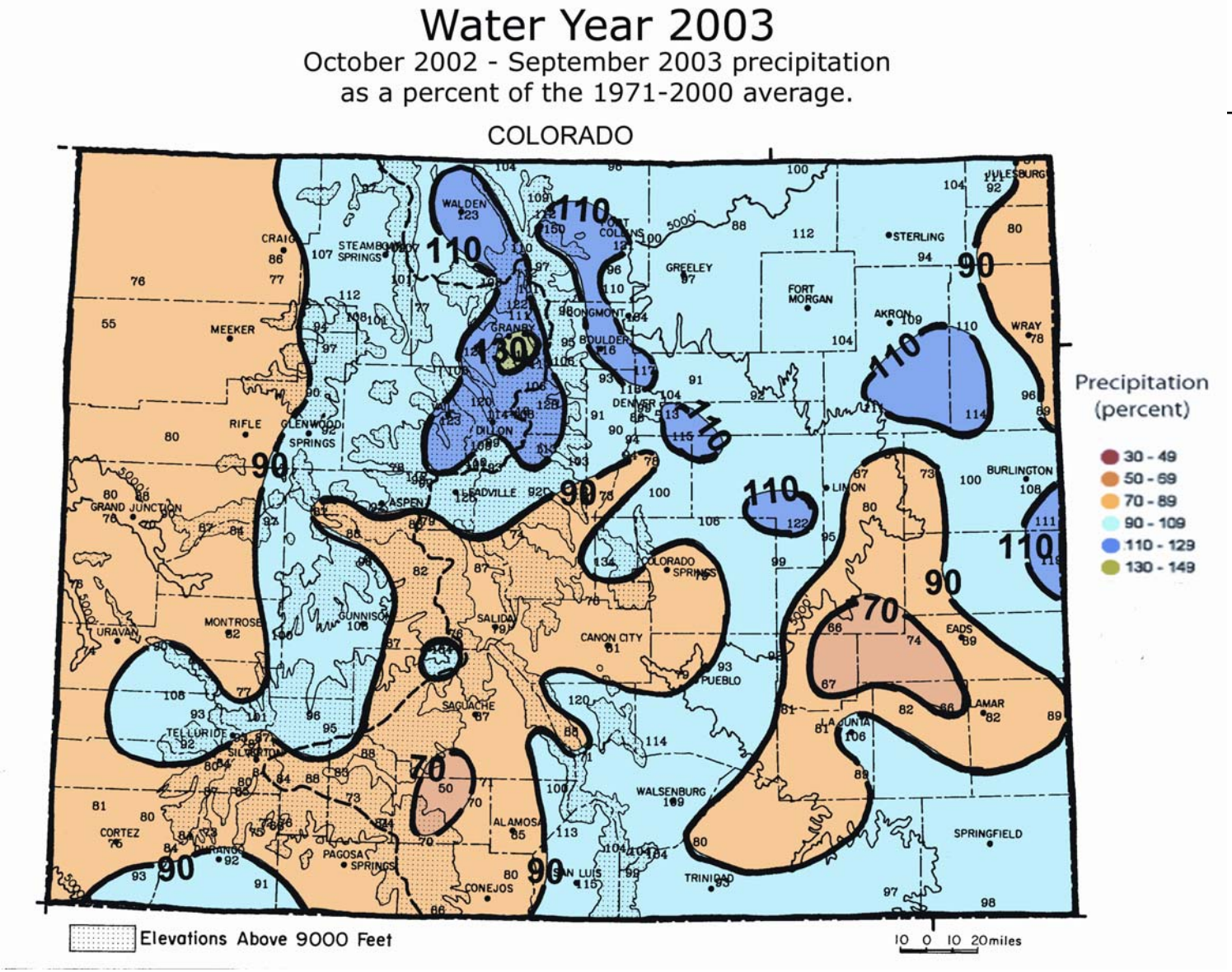
Water Year 2002

(Oct. 2001 - Sept. 2002)

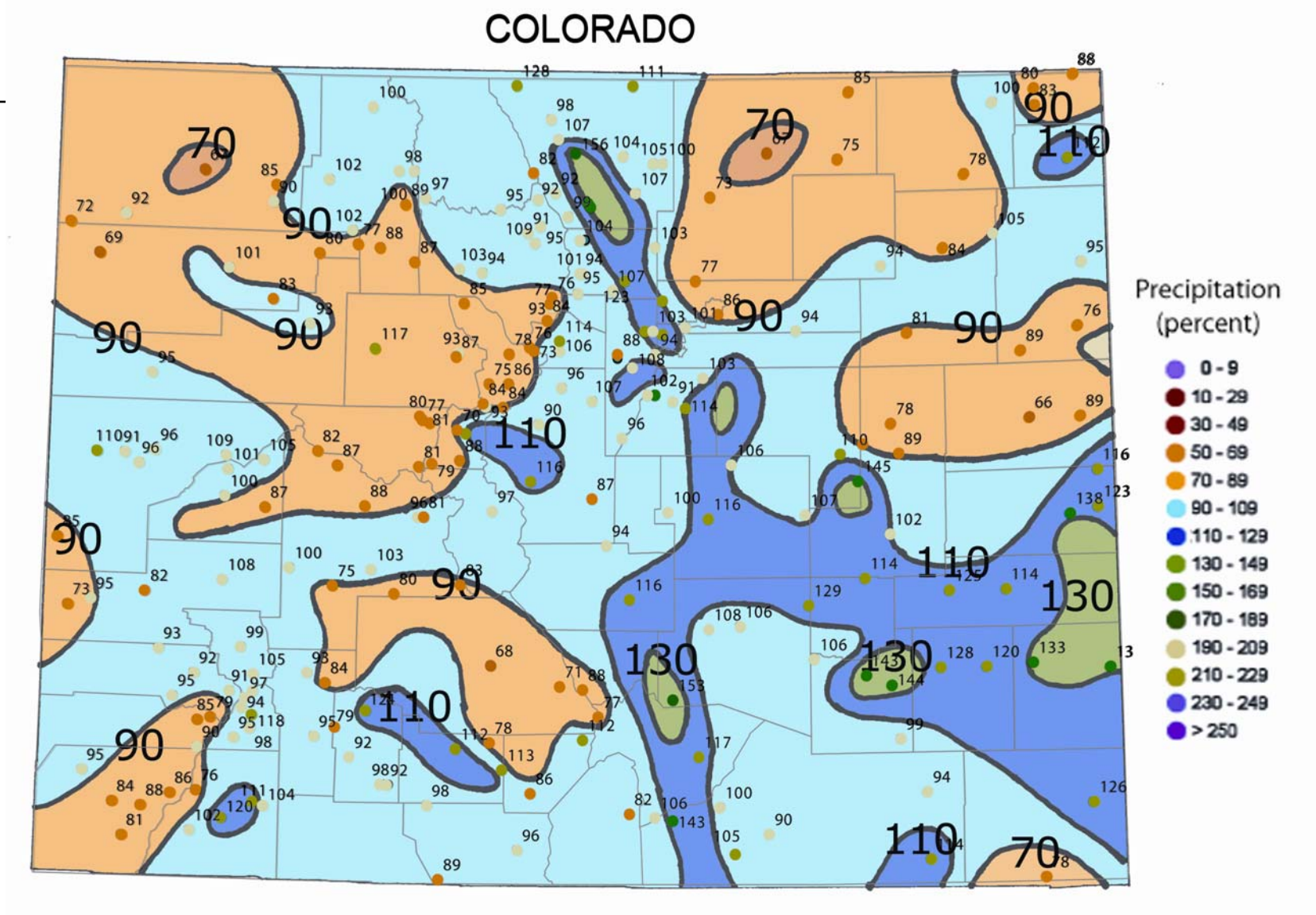
Precipitation Percent of Average for 1961-1990 Averages



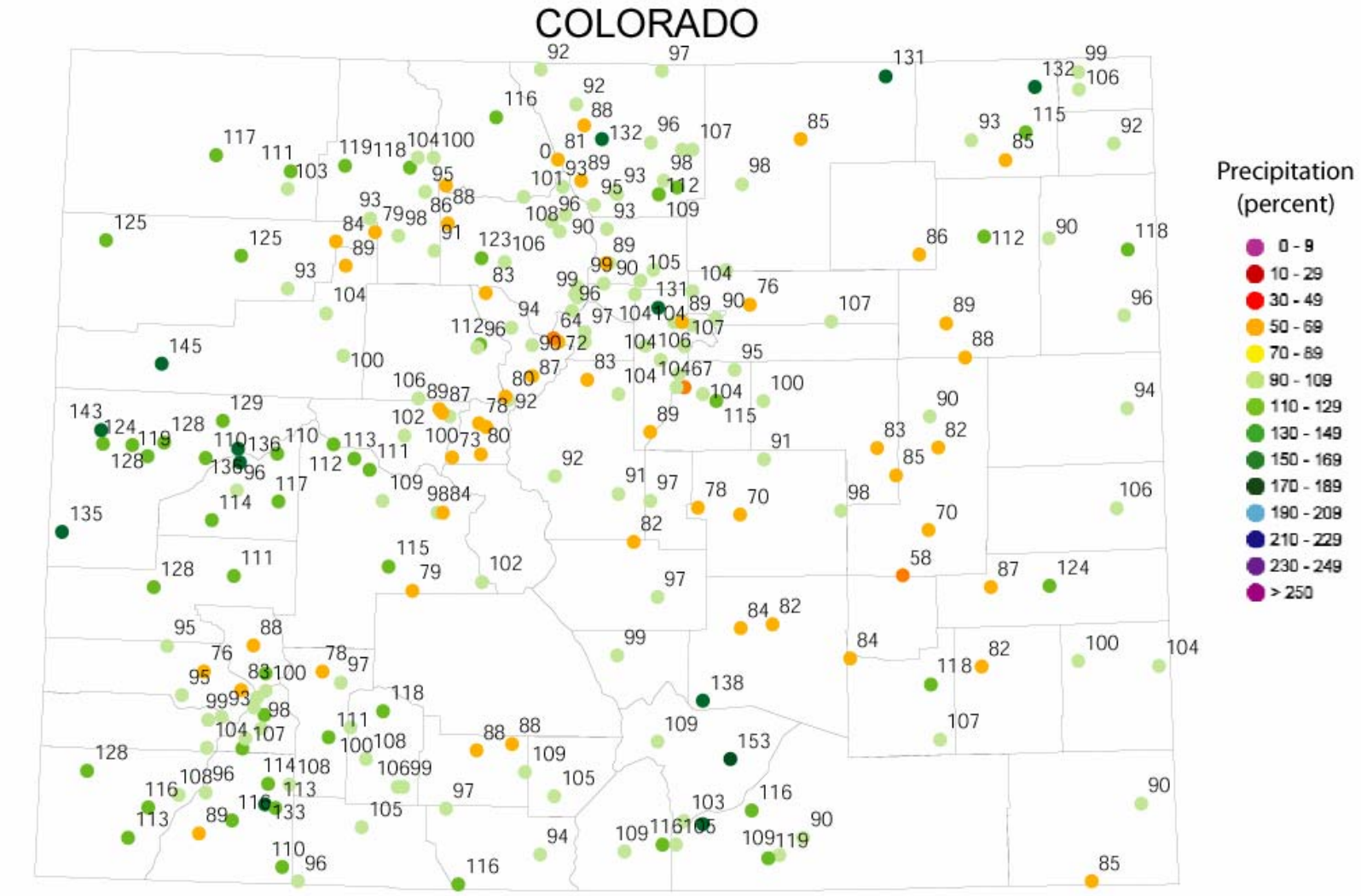
2003 Water Year Precipitation



2004 Water Year Precipitation

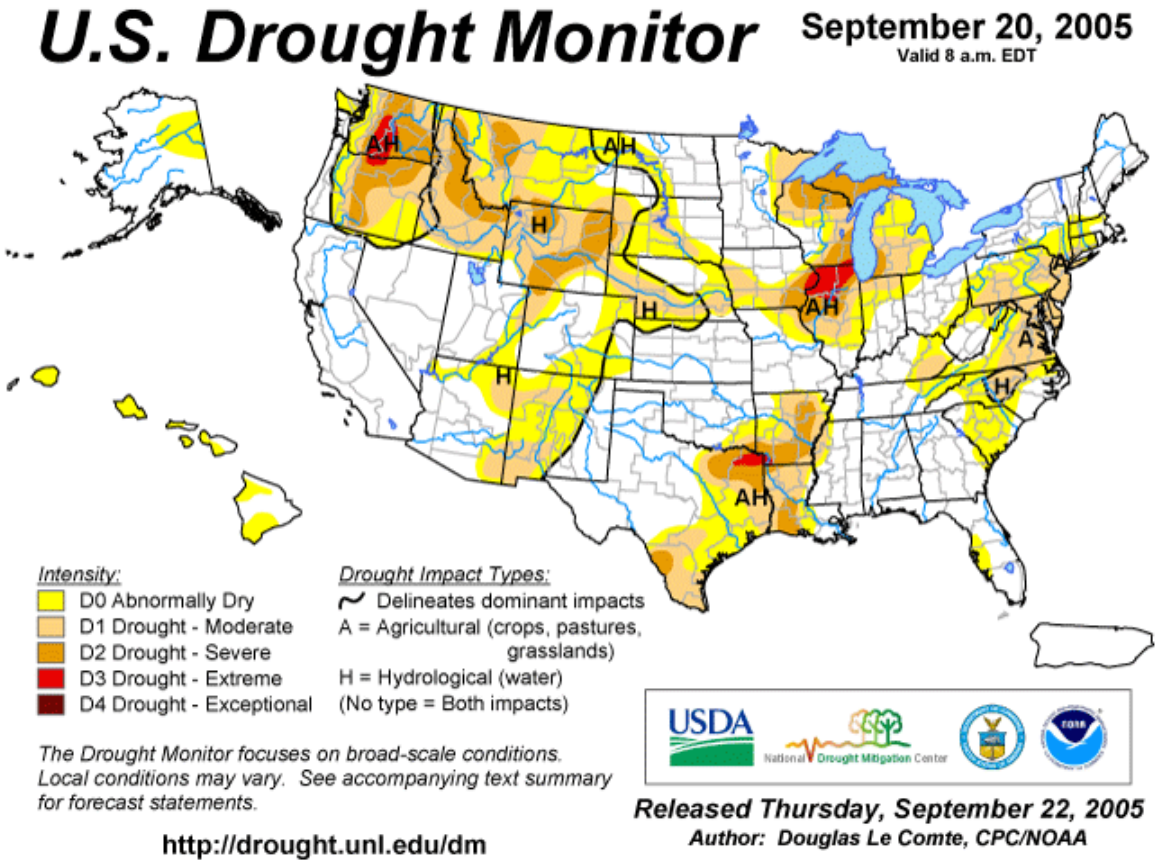


2005 Water Year Precipitation

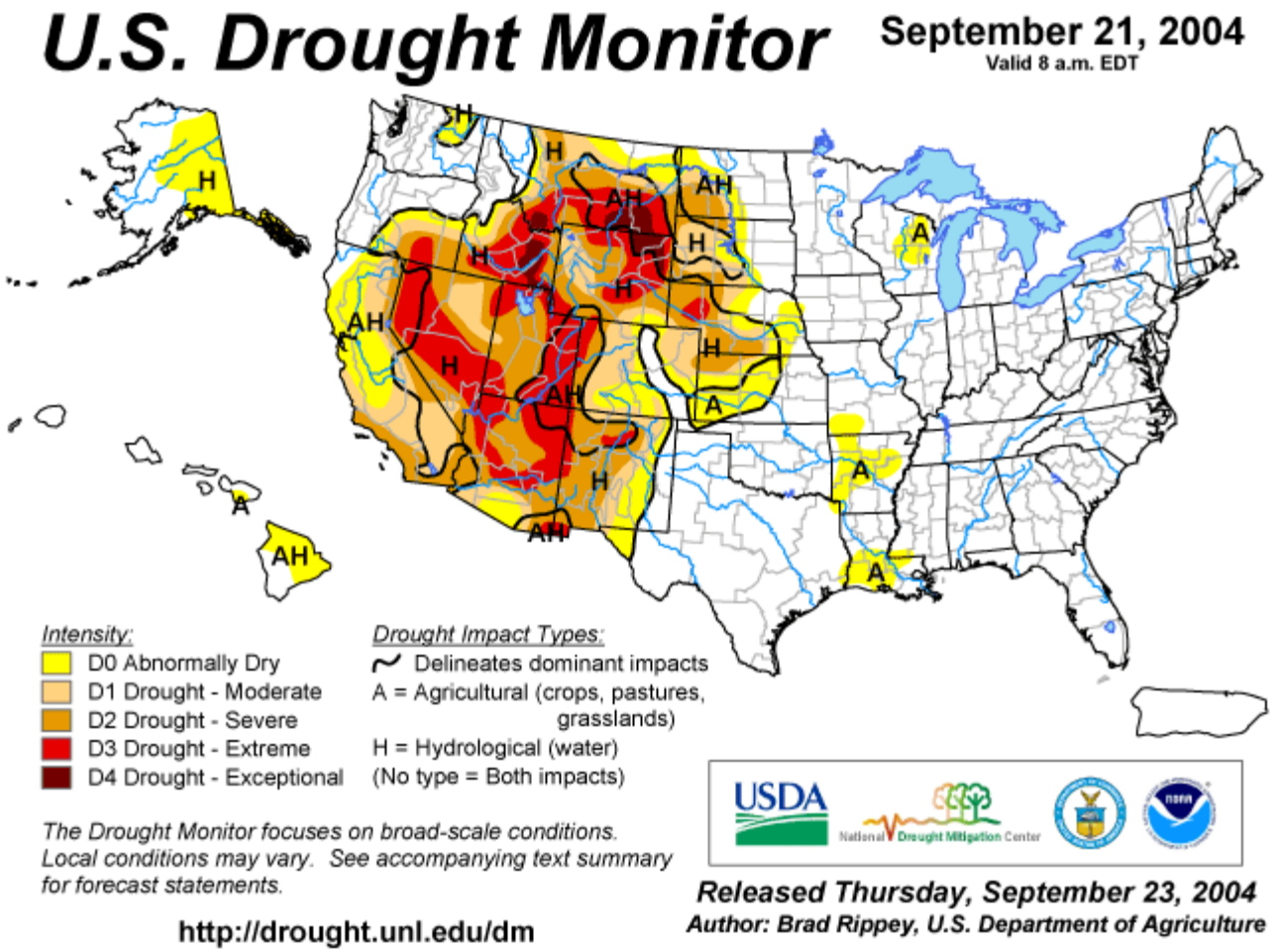


Water Year 2005 (October 2004 through August 2005) precipitation as a percent of the 1971-2000 average.

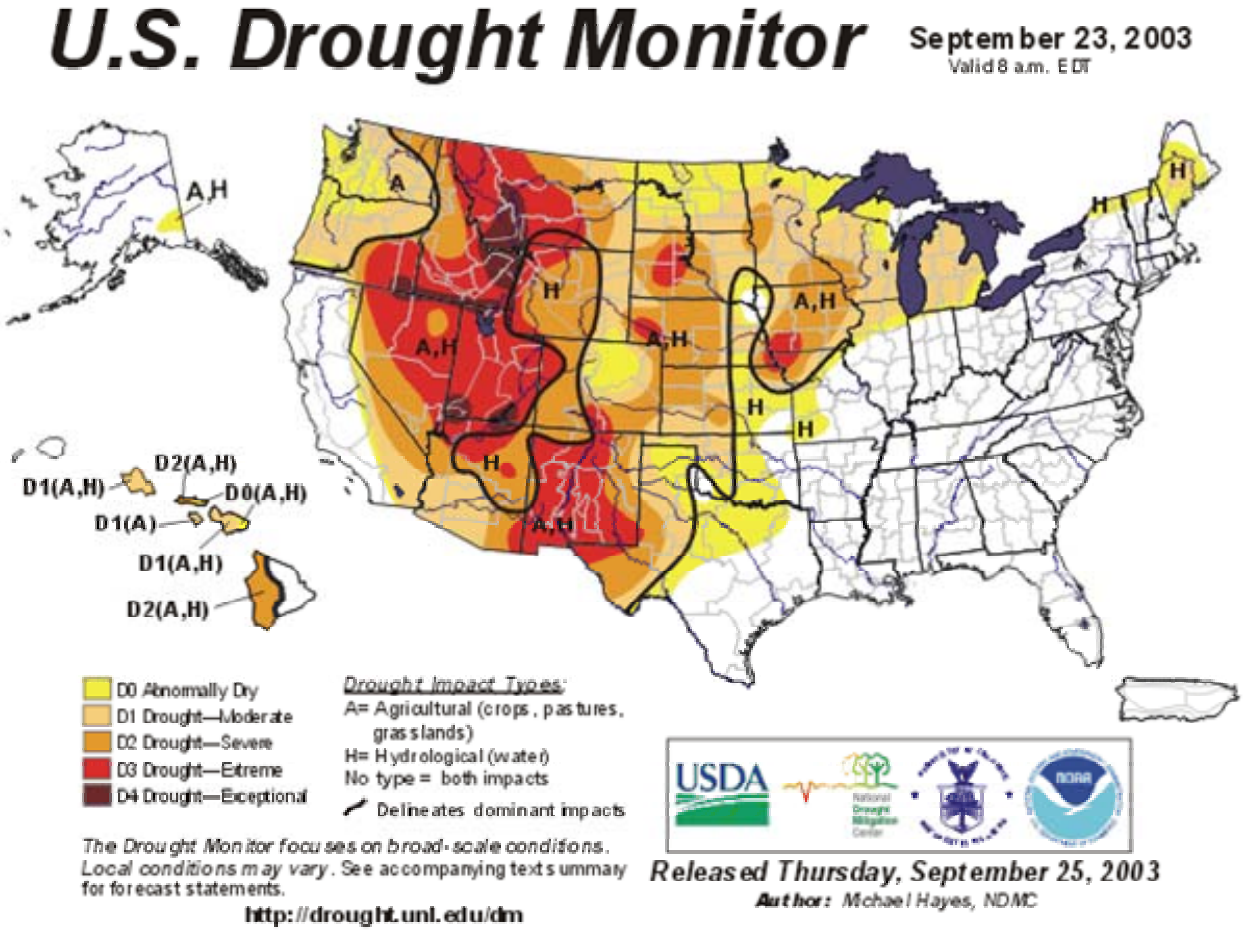
Drought Monitor – Sep 20, 2005



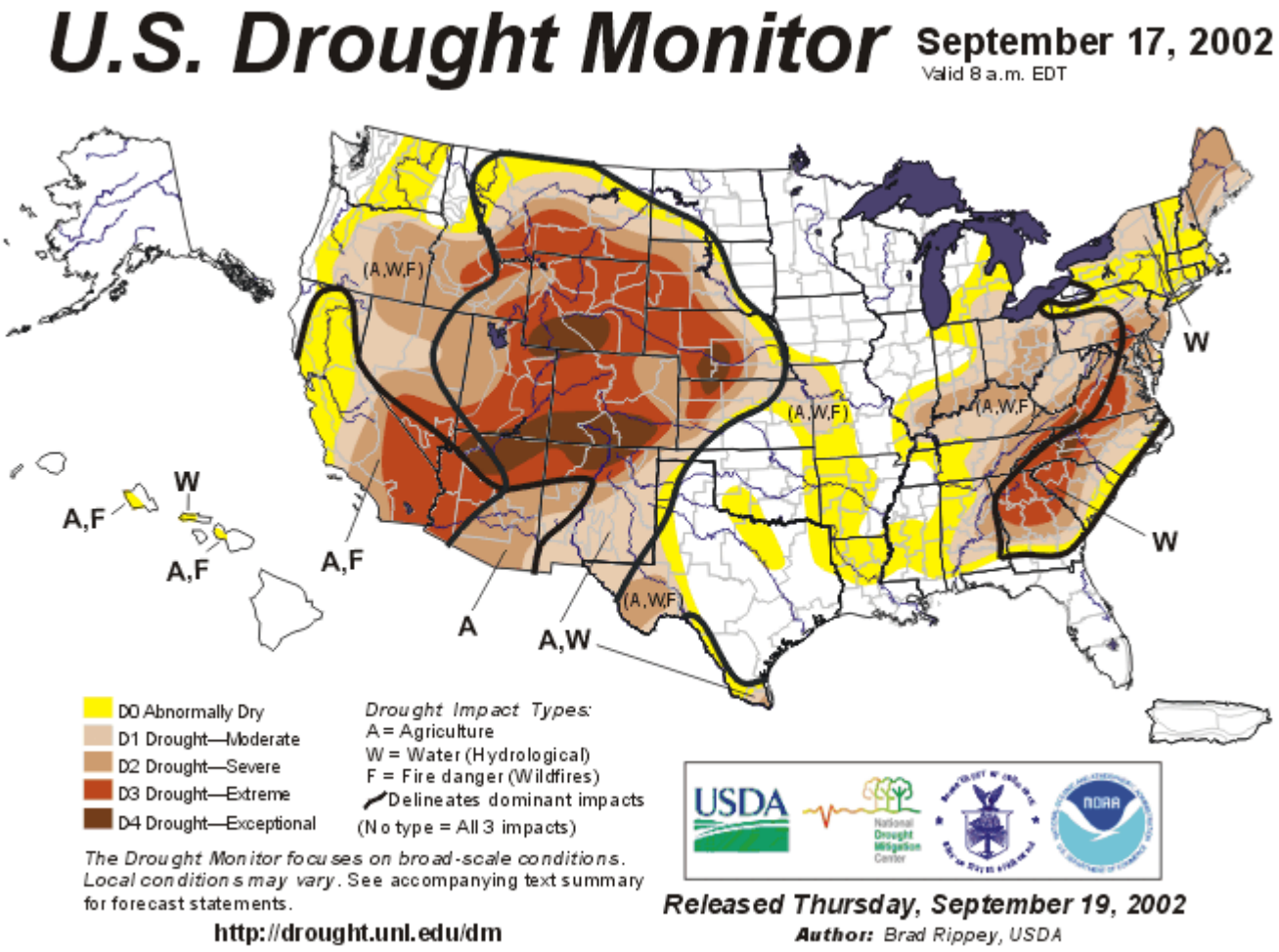
Drought Monitor – Sep 21, 2004



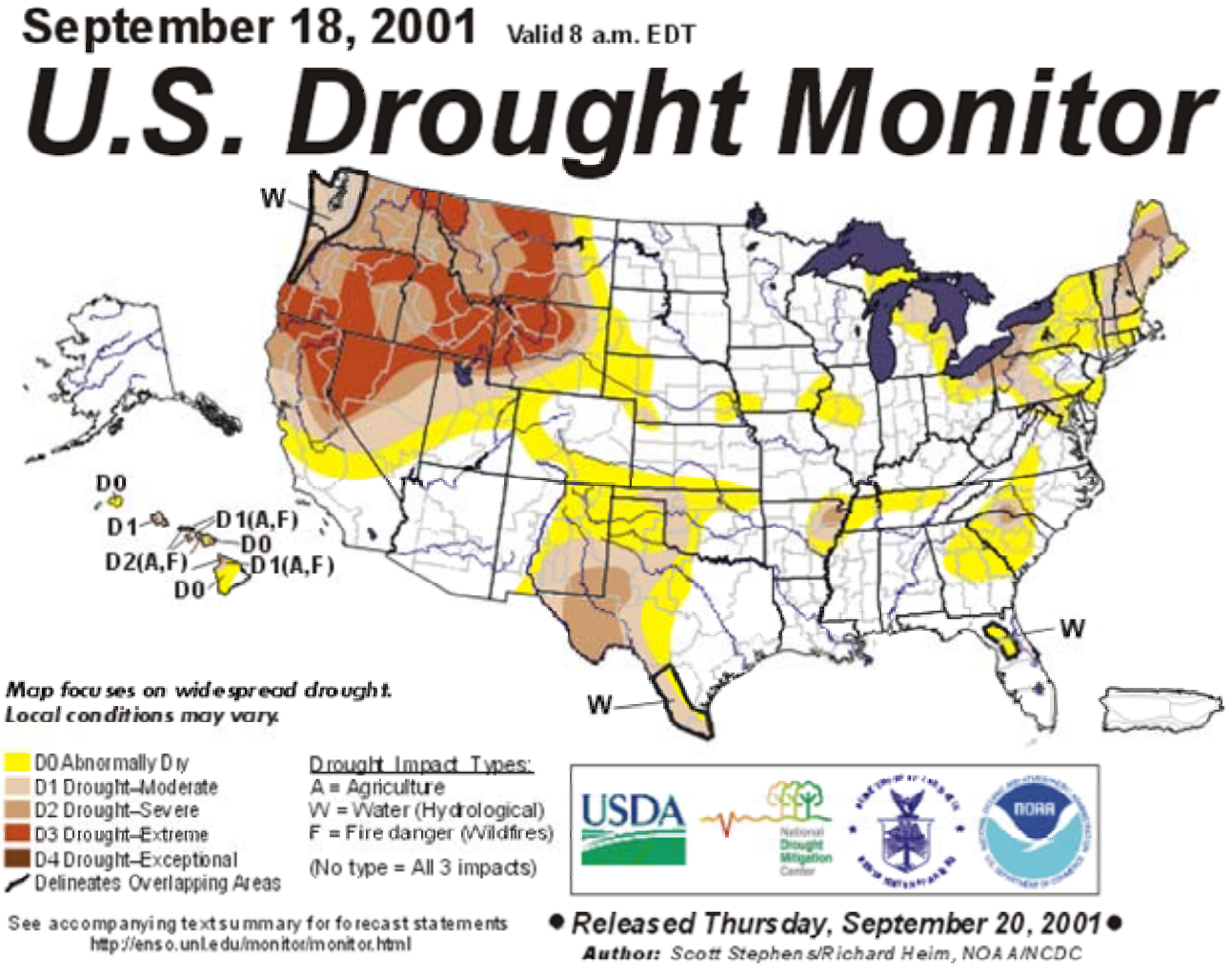
Drought Monitor – Sep 23, 2003



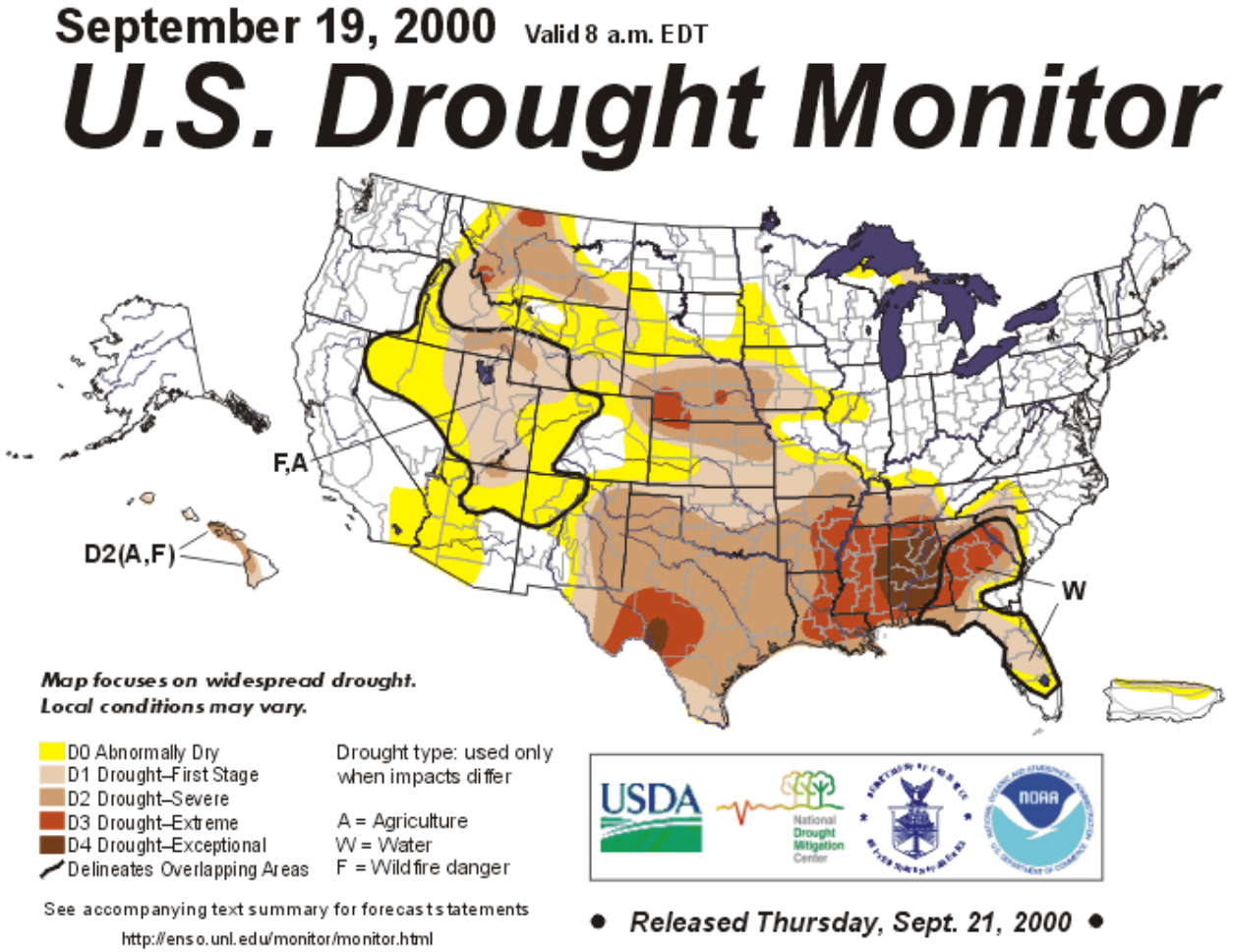
Drought Monitor – Sep 17, 2002



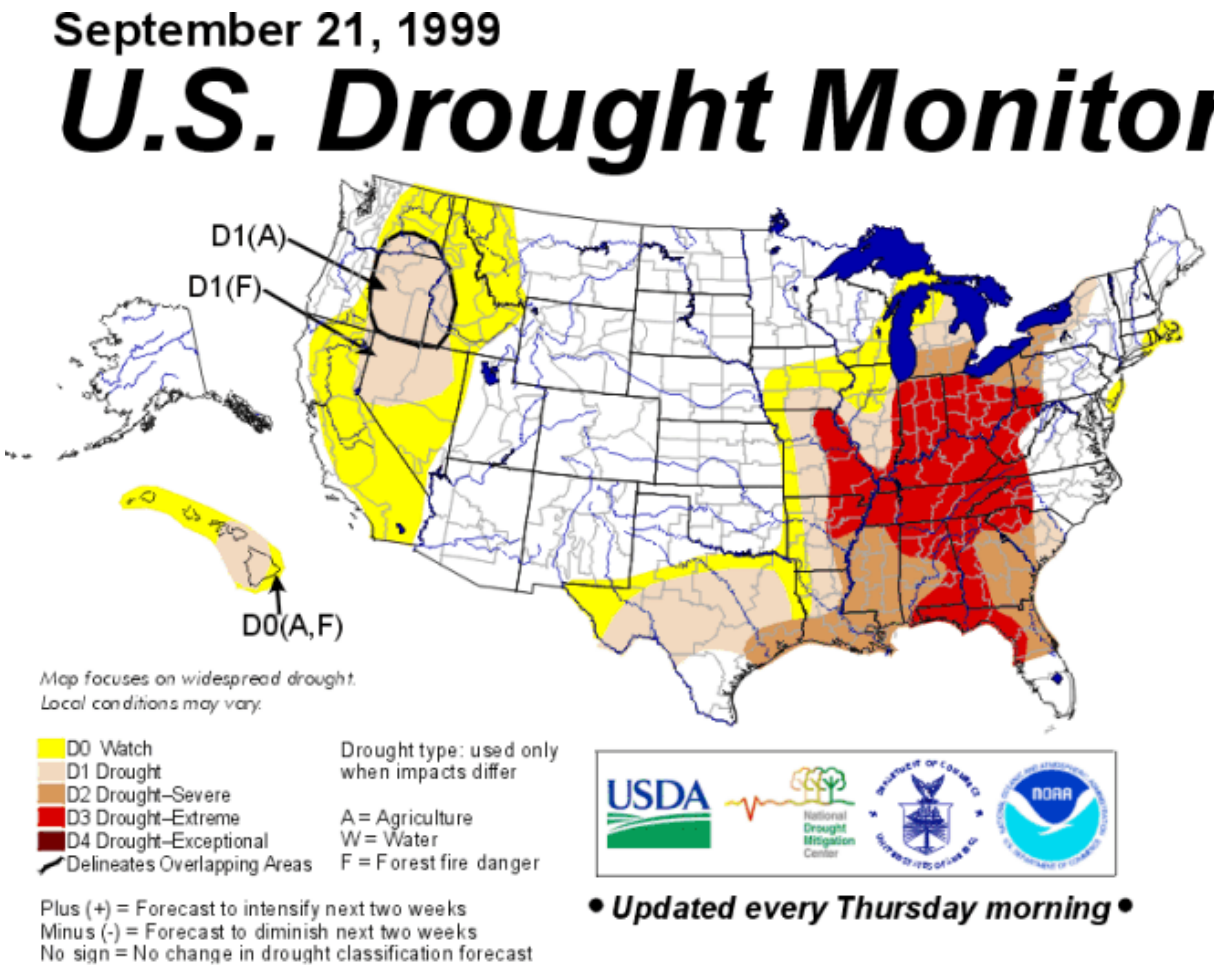
Drought Monitor – Sep 18, 2001



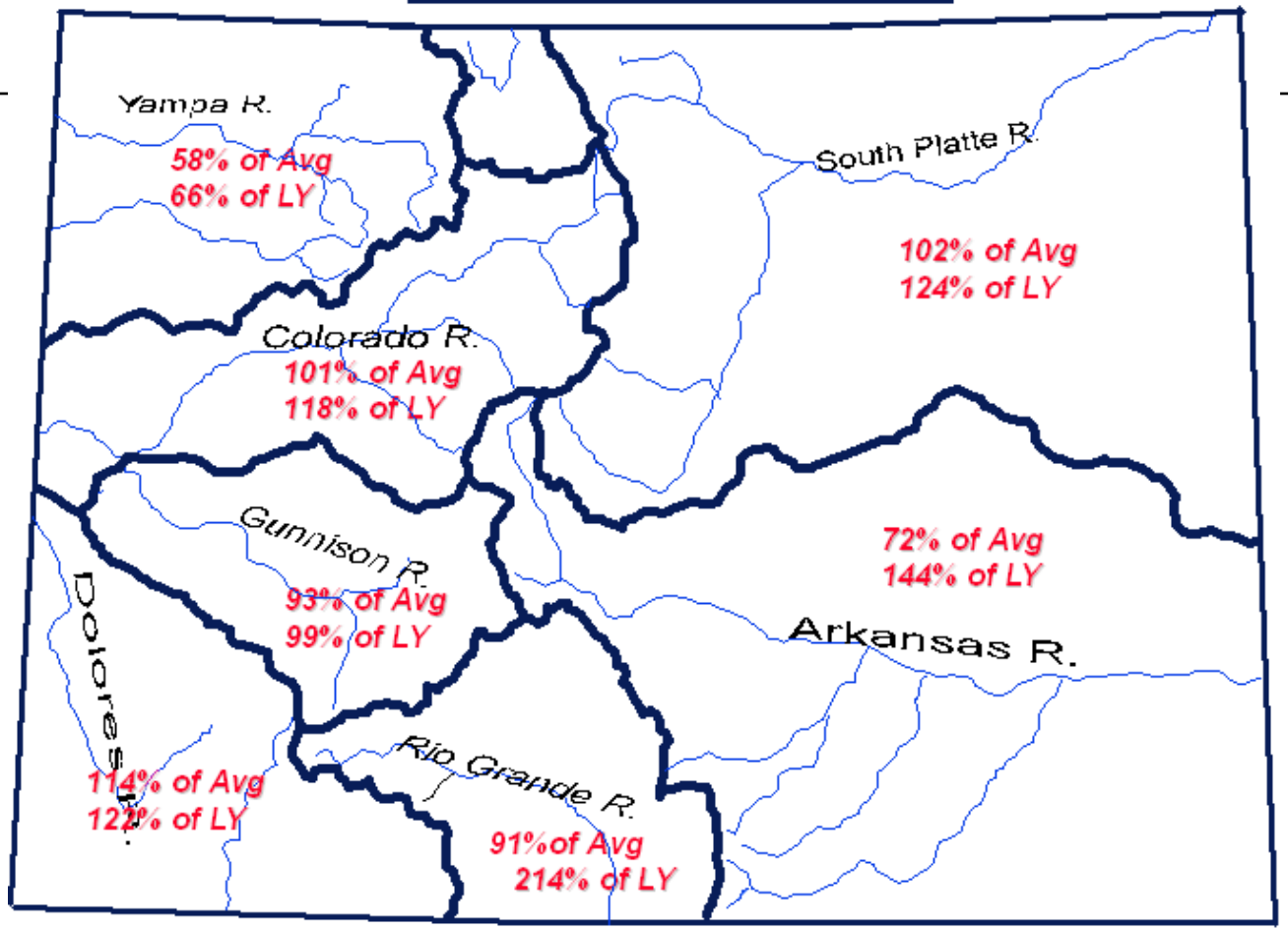
Drought Monitor – Sep 19, 2000



Drought Monitor – Sep 21, 1999



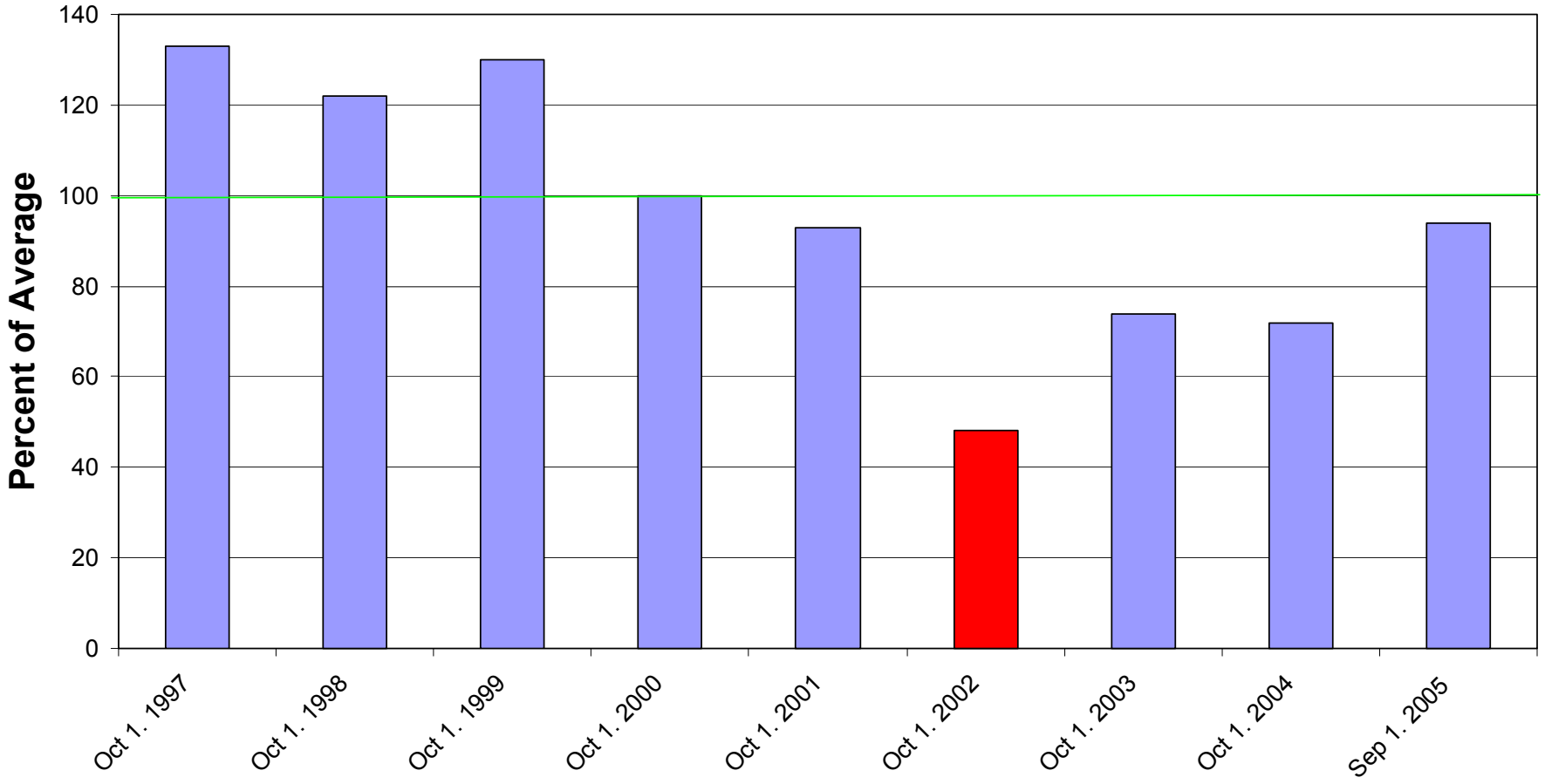
Reservoir Storage
July 1, 2005



Statewide: 96% of Average
118% of Last Year

http://www.co.nrcs.usda.gov/snow/watersupply/

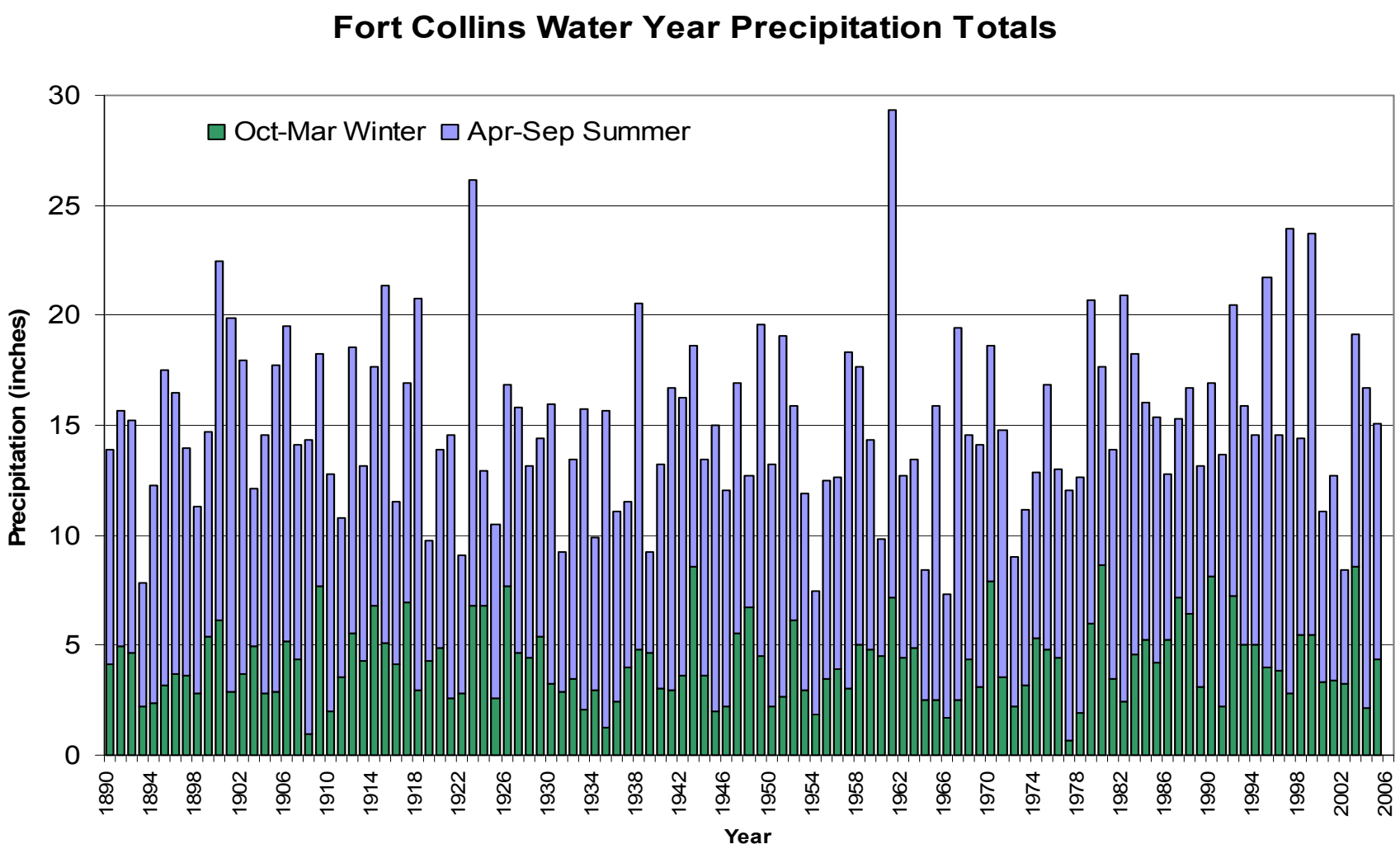
Colorado Statewide Reservoir Levels on October 1st for Years 1997- 2004 and Sep 1, 2005



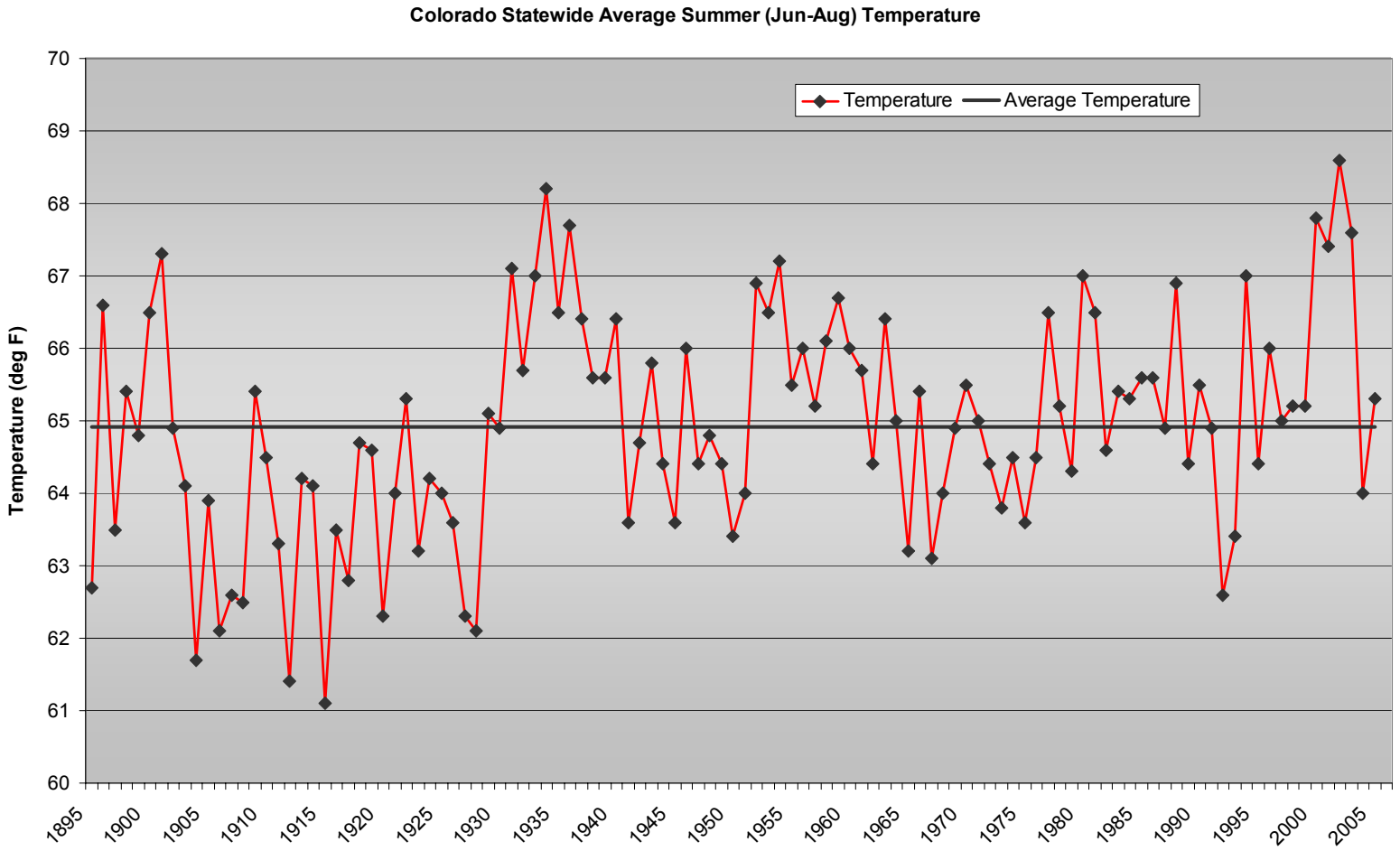
Provisional Data Provided by NRCS

Longer Term Perspective

Fort Collins Water Year Precipitation Total for Summer and Winter,1890-2005

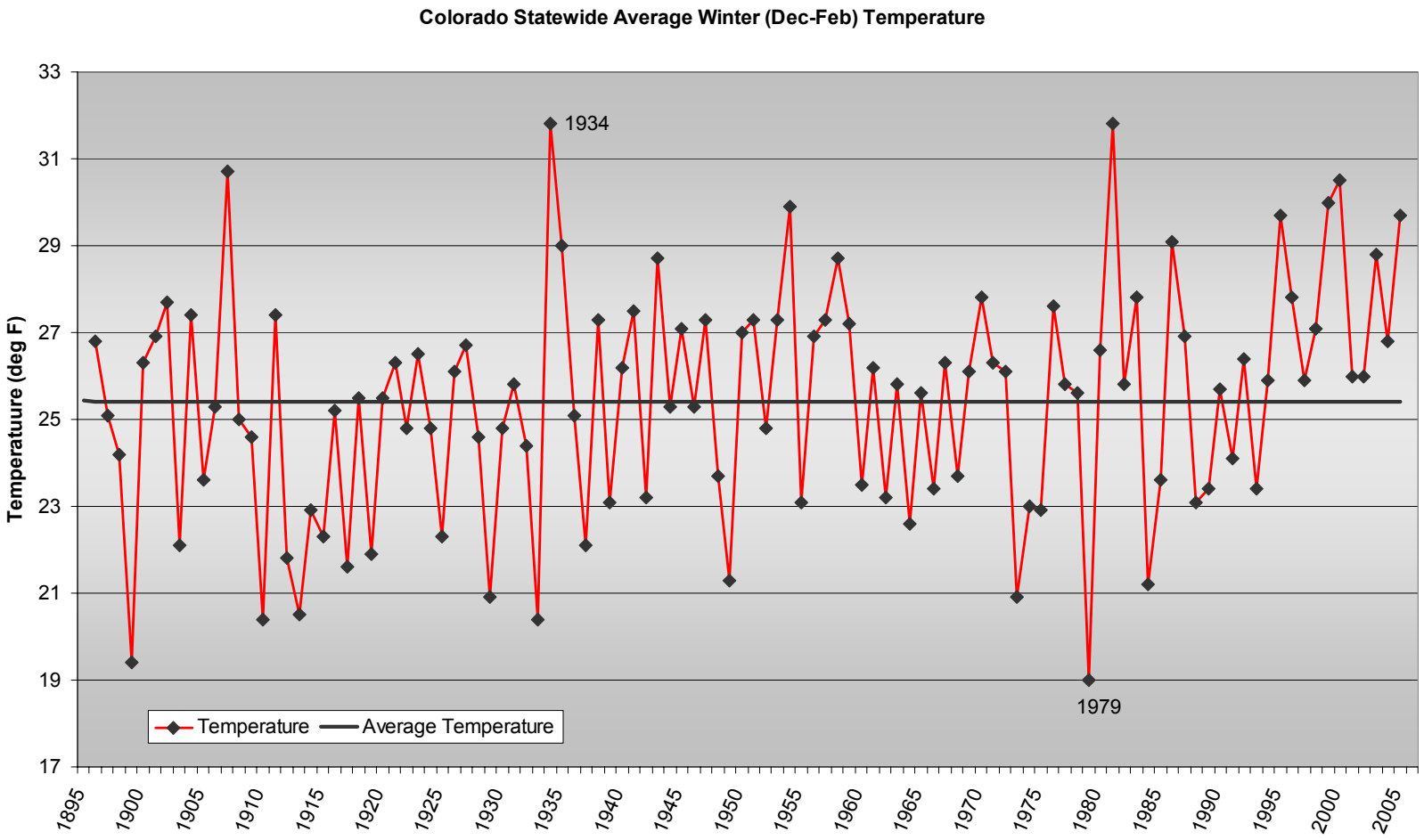


Colorado average summer (Jun-Aug) temperature, 1895-2005

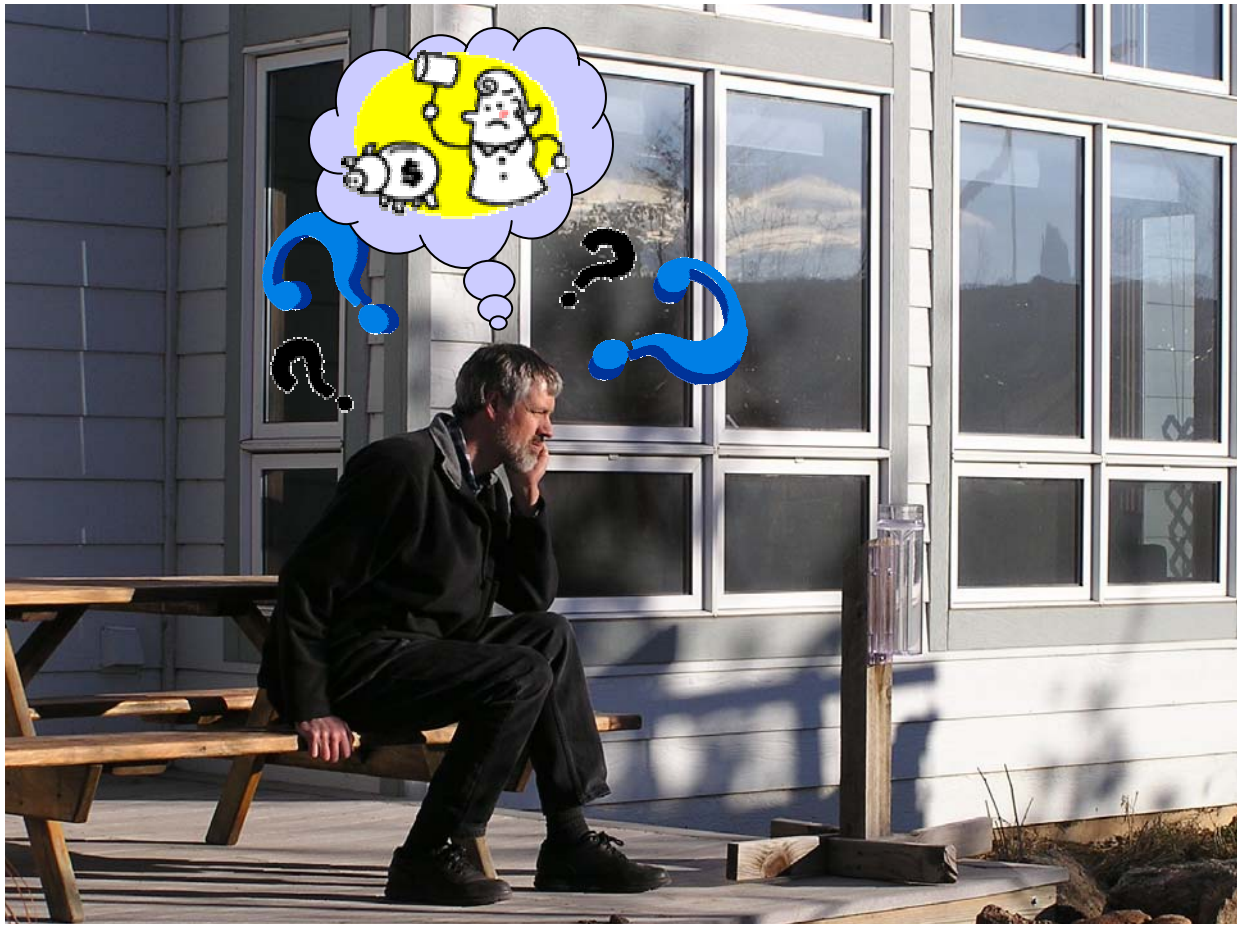


http://www.ncdc.noaa.gov/oa/climate/research/cag3/co.html

Colorado average winter (Dec-Feb) temperature, 1895-2005



How can we gather more data without breaking the bank??



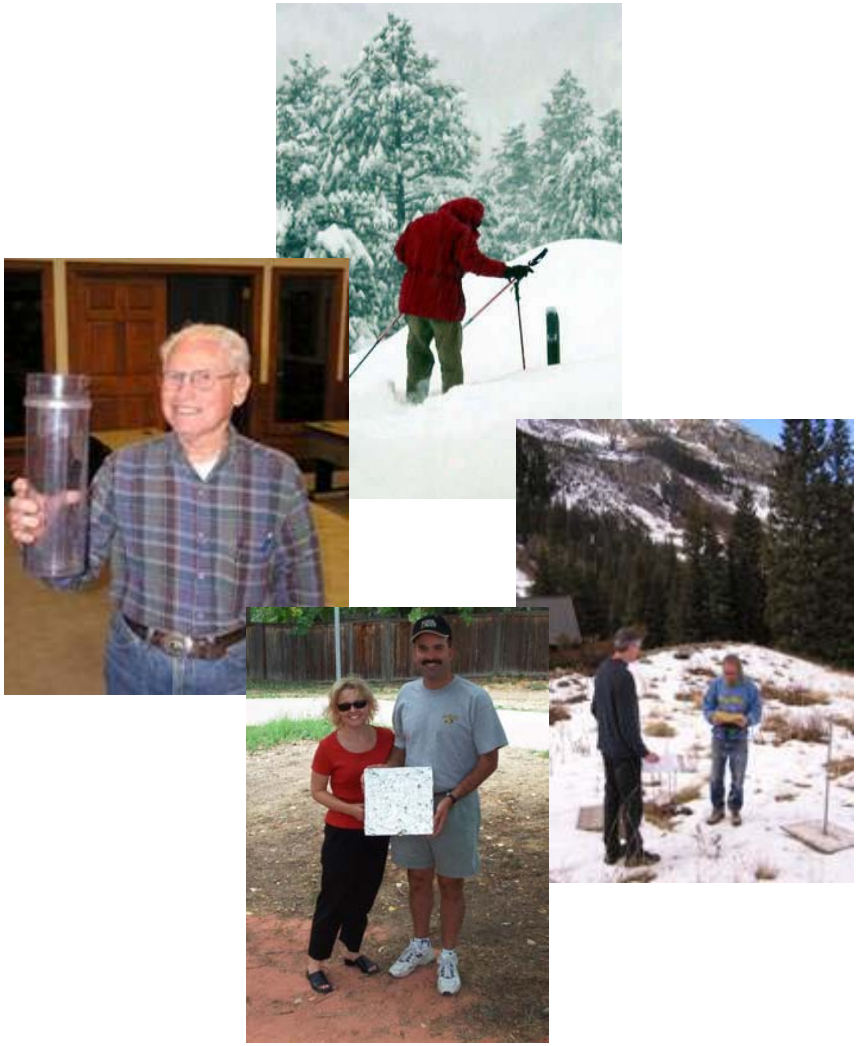
Community Collaborative Rain, Hail and Snow Network

The Origin of CoCoRaHS

The Fort Collins Flood of July 28, 1997

What is CoCoRaHS?

CoCoRaHS is a unique, non-profit community based network of volunteers of all ages and backgrounds working together to measure and map precipitation (rain, hail and snow).



CoCoRaHS: Simple tools to study rain

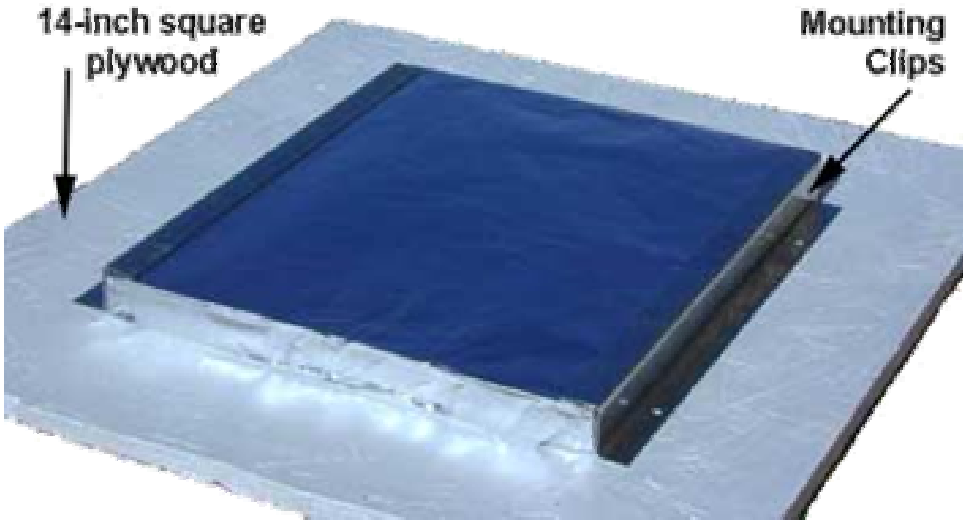
Rain Gauge

Example Station

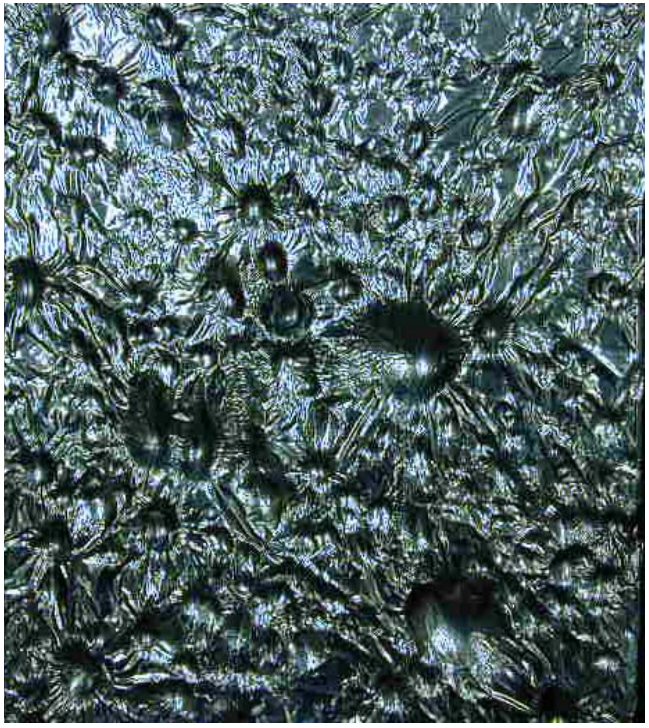
CoCo RaHS Gauge in March 2003 Snowstorm

Arapahoe County CoCo RaHS observer near Cherry Creek, Colorado

CoCoRaHS: Simple Tools to Study Hail



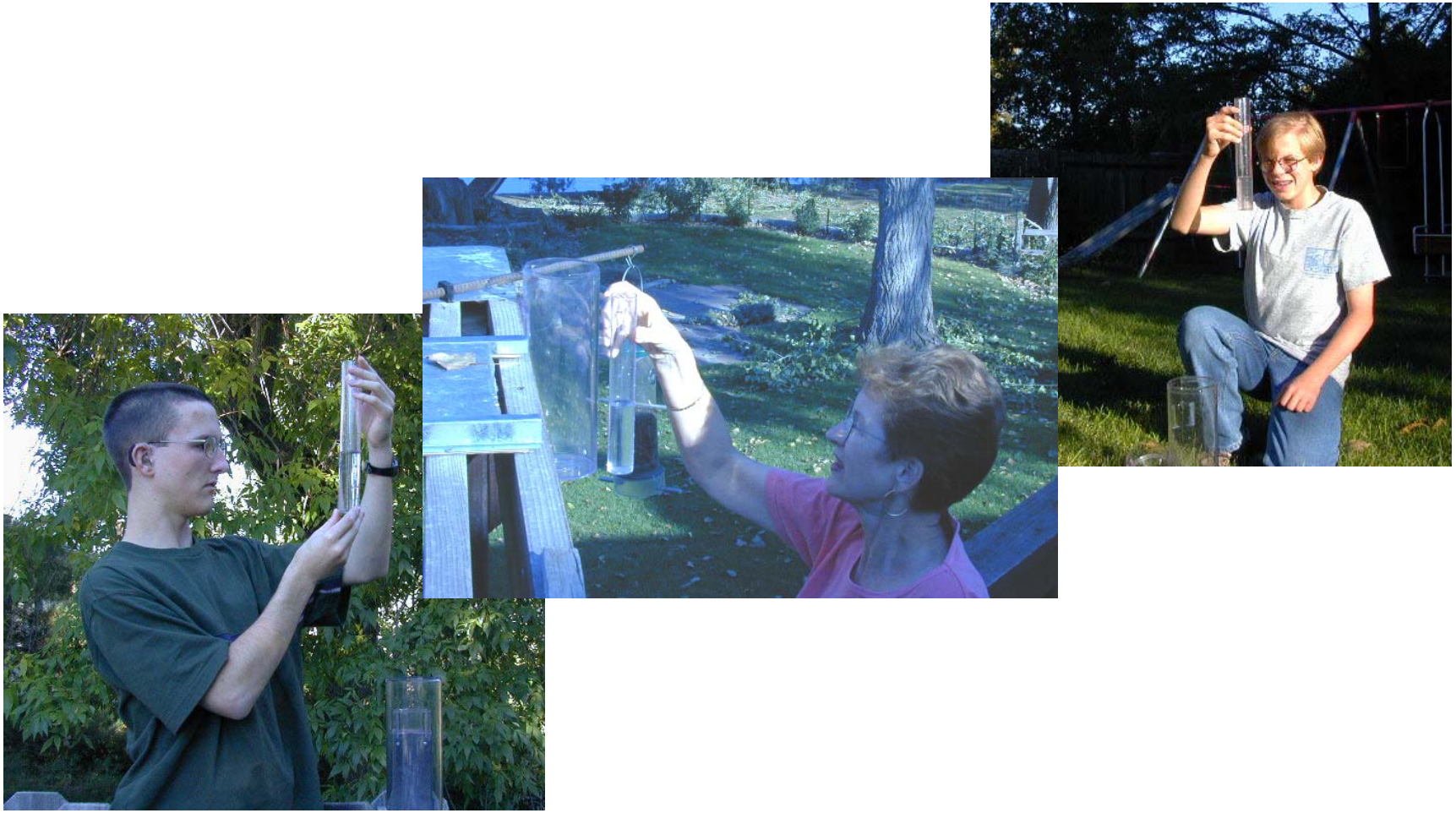
Hail Pad



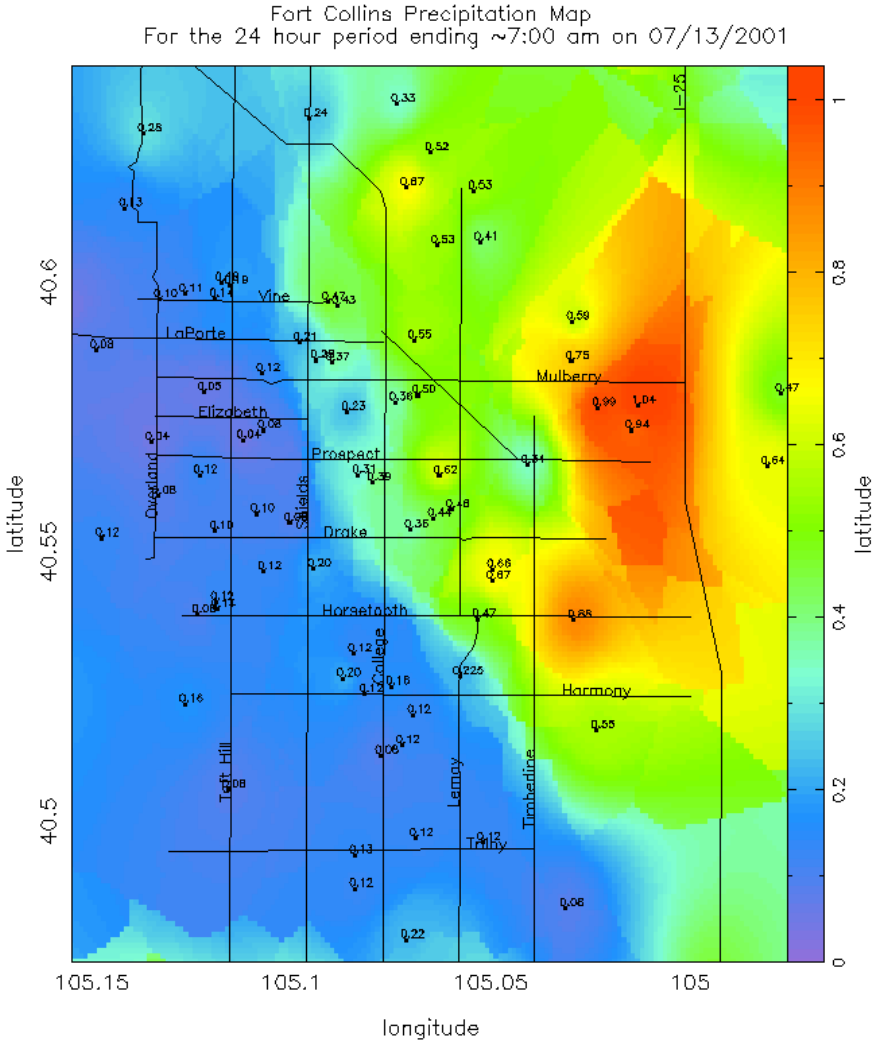
Damaged Hail Pad

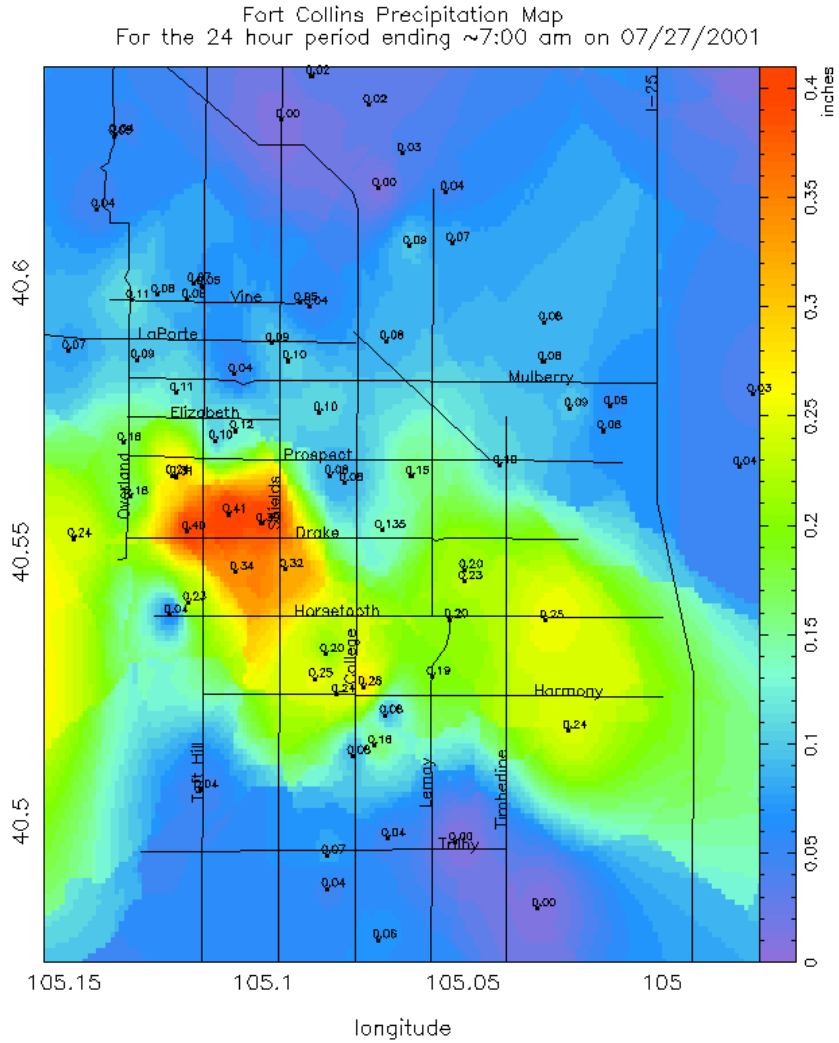
Example Hail Pad Stands

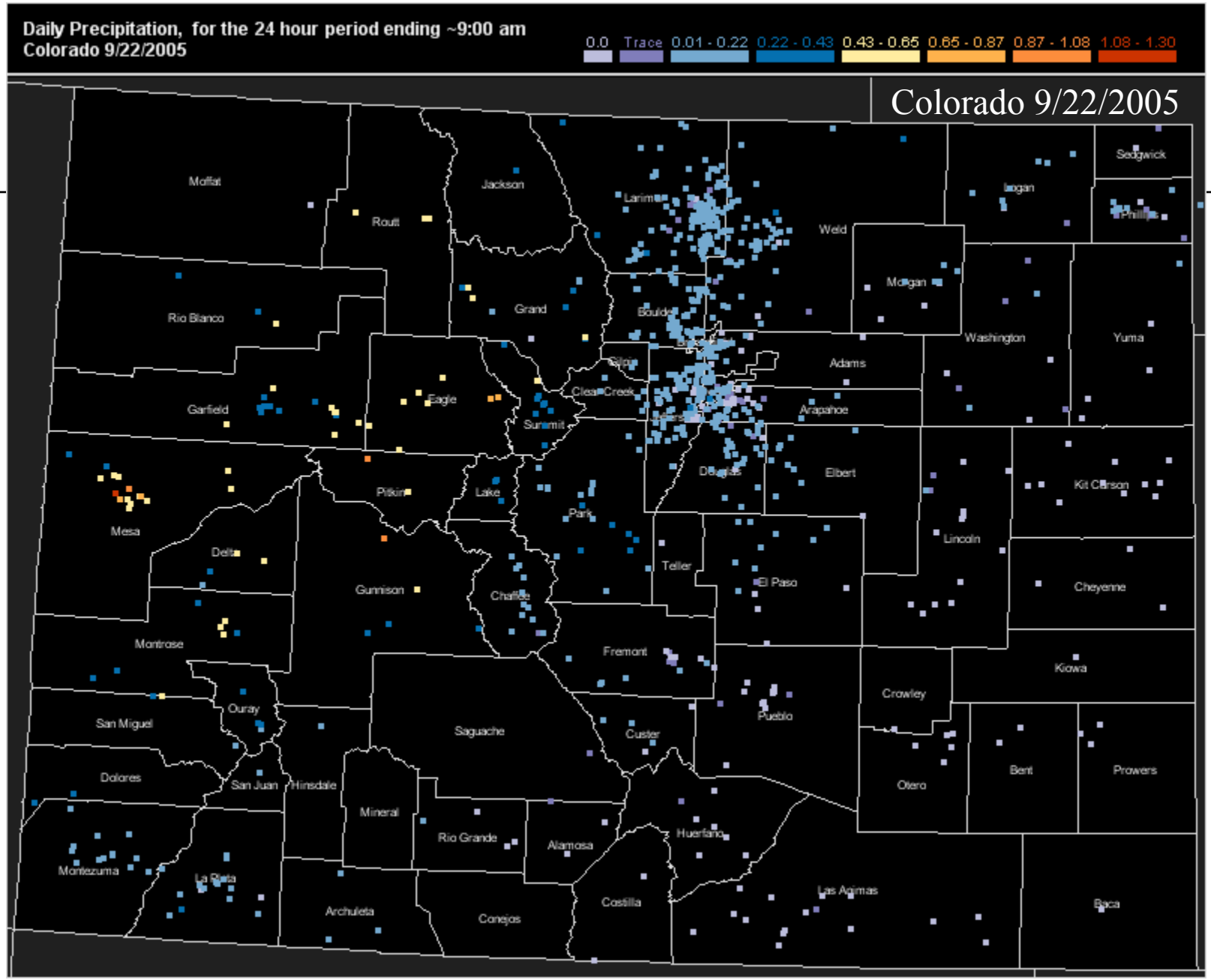
CoCoRaHS -- Supplementing NWS Cooperative Program to Improve Precipitation Measurements.

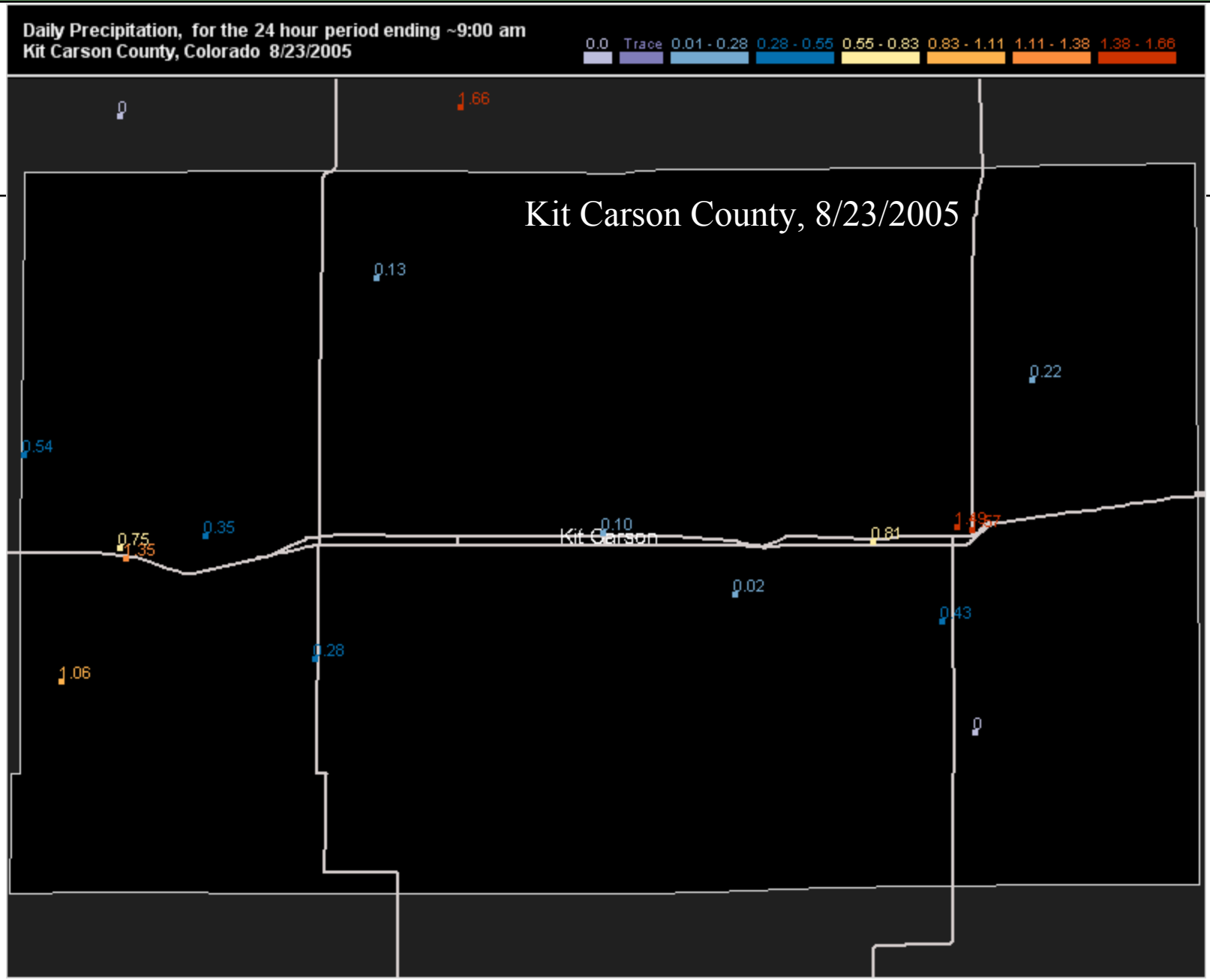


Fort Collins Daily Rainfall Examples



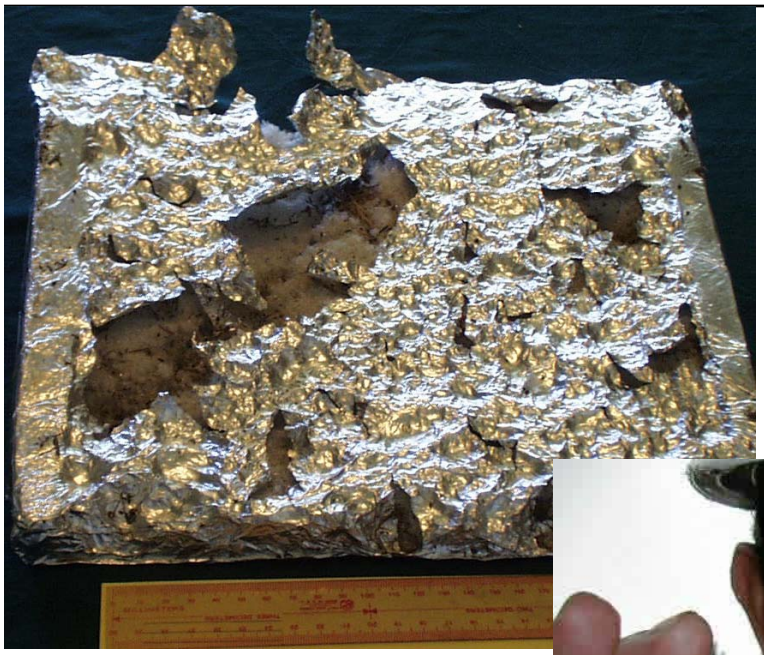



Daily Precipitation, for the 24 hour period ending ~9:00 am
Colorado 9/22/2005
0.0
Trace
0.01 - 0.22
0.22 - 0.43
0.43 - 0.65
0.65 - 0.87
0.87 - 1.08
1.08 - 1.30
Colorado 9/22/2005
Moffat
Routt
Jackson
Larimer
Weld
Logan
Sedgwick
Phillips
Rio Blanco
Grand
Boulder
Morgan
Washington
Yuma
Garfield
Eagle
Summit
Clear Creek
Adams
Arapahoe
Elbert
Kit Carson
Pitkin
Lake
Park
Douglas
Mesa
Delta
Gunnison
Chaffee
Teller
El Paso
Lincoln
Cheyenne
Montrose
Fremont
Kiowa
Ouray
San Miguel
Saguache
Custer
Pueblo
Crowley
Dolores
San Juan
Hinsdale
Mineral
Rio Grande
Alamosa
Huerfano
Otero
Bent
Prowers
Montezuma
La Plata
Archuleta
Conejos
Costilla
Las Animas
Baca


Daily Precipitation, for the 24 hour period ending ~9:00 am
Kit Carson County, Colorado 8/23/2005
0.0 Trace 0.01 - 0.28 0.28 - 0.55 0.55 - 0.83 0.83 - 1.11 1.11 - 1.38 1.38 - 1.66
Kit Carson County, 8/23/2005
0
1.66
0.13
0.22
0.54
0.75
1.35
0.35
0.10
Kit Carson
0.81
0.02
0.43
0.28
1.06
0

Colorado Hailstorm

July 10, 2002, Parker, CO



Expanded Hail Information from Web Site

Date: 7/3/2002
Hail Began: 2:56pm
Hail Lasted: 10 minutes

Station Number: 560
Name:Greeley 4.3 NNW
County: Weld

Common Stones: Pea
Largest Stones: Marble
Smallest Stones: Pea

Hailfall was: Intermittently

Hailstones were: Hard, Mixed

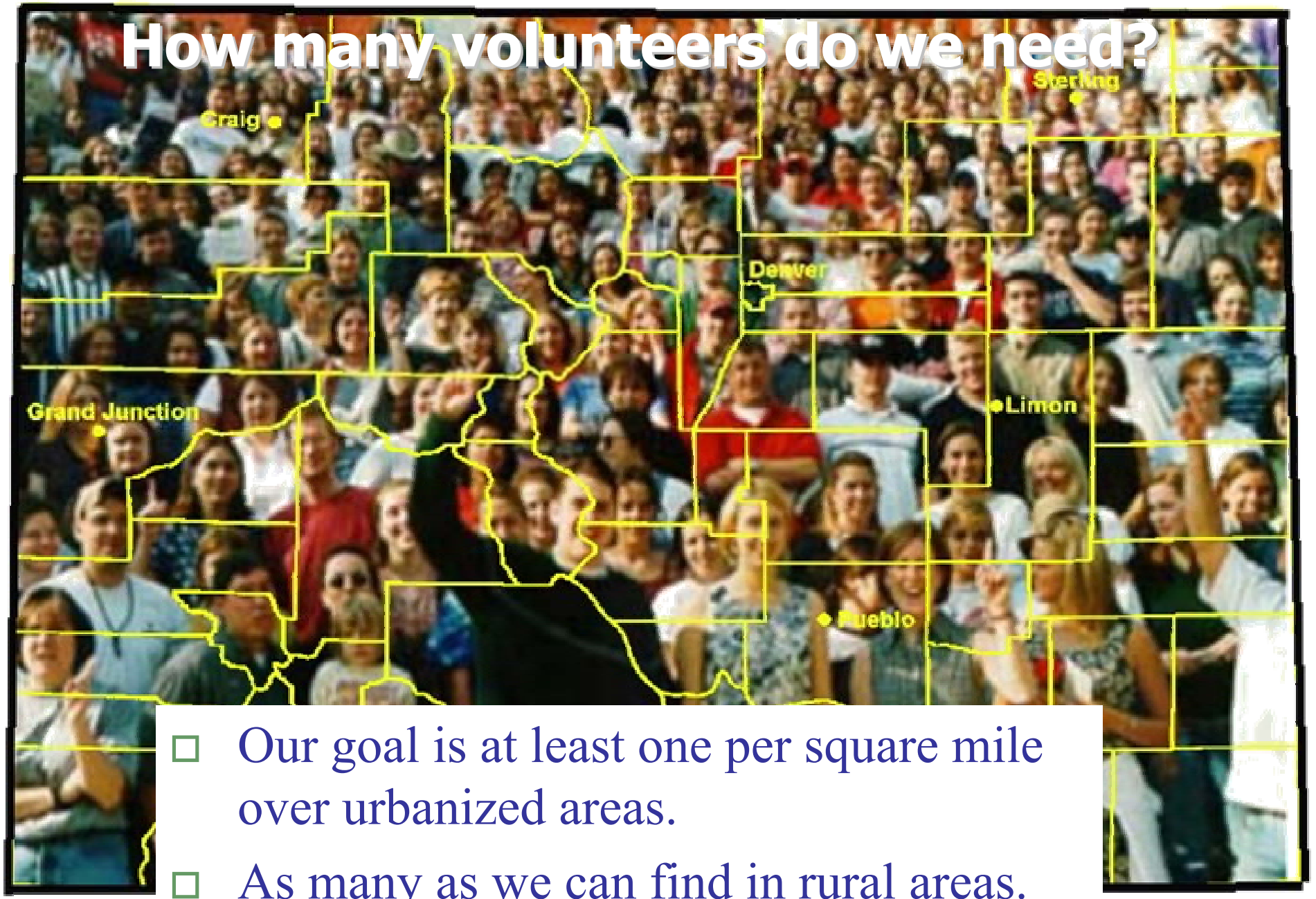
Hail started: same time as rain

Average distance between stones: 1/16 inches

Depth of hail:

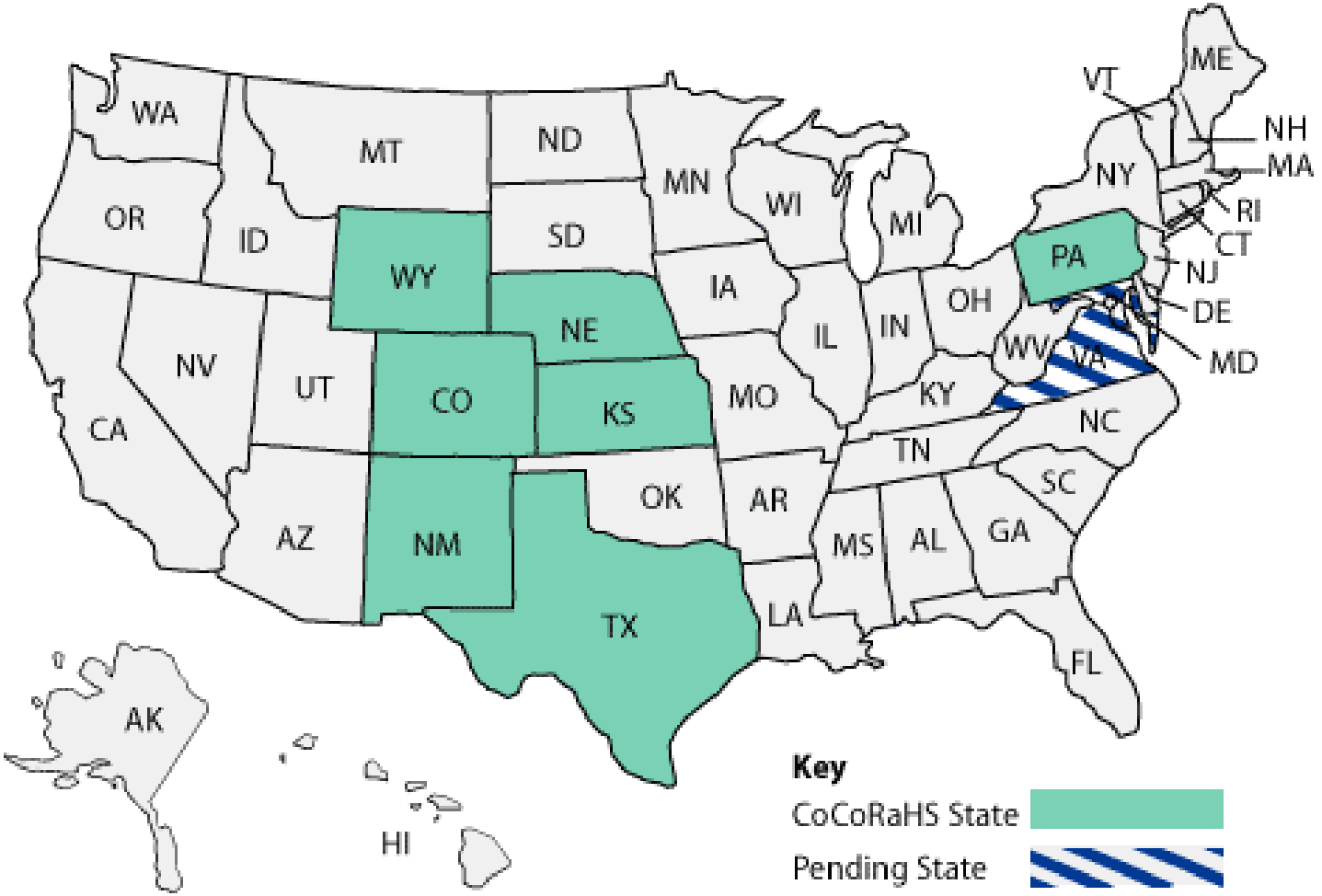
Comments:*None*

How many volunteers do we need?



- Our goal is at least one per square mile over urbanized areas.
- As many as we can find in rural areas.

Participating CoCoRaHS States



For More Information, Visit the CoCoRaHS Web Site

http://www.cocorahs.org

Support for this project provided by
Informal Science Education Program,
National Science Foundation
and
many local charter sponsors.

Colorado Climate Center

Data and Power Point Presentations available for downloading

http://ccc.atmos.colostate.edu

- click on “Drought”
- then click on “Presentations”

Colorado State University
Knowledge to Go Places